THE FOUNDRY

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Molding Large, Iron, Generator Field Frames

How These Castings Were Made True to Pattern and Without Distortion—The Metal Entered the Mold Through Staggered Gates

WHEN making long castings of comparatively thin sections, whether curved or straight, considerable difficulty is experienced frequently from warping resulting in the distortion of the casting. Cambering the pattern in the direction opposite to the warping is occasionally resorted to by many foundrymen, and while the casting may come out of the sand true to pattern, nevertheless the practice, at best, is uncertain. Proper design is the controlling factor which underlies the prevention of warping and if the designer bears the foundryman's difficulties in mind, the losses produced by warped castings would be reduced materially.

Recently the Cleveland foundry of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., received an order for four gray iron field frames, 26 feet in diameter and about 9-foot face, the metal throughout averaging 1½ inches in thickness. The frames were made in halves, making a total of eight castings and are for four 13,500 kilovolt-amperes, alternating current, vertical water wheel-driven generators, 60 cycles, 6,600 volts, which will operate at the low speed of 100 revolutions per minute. The generators are

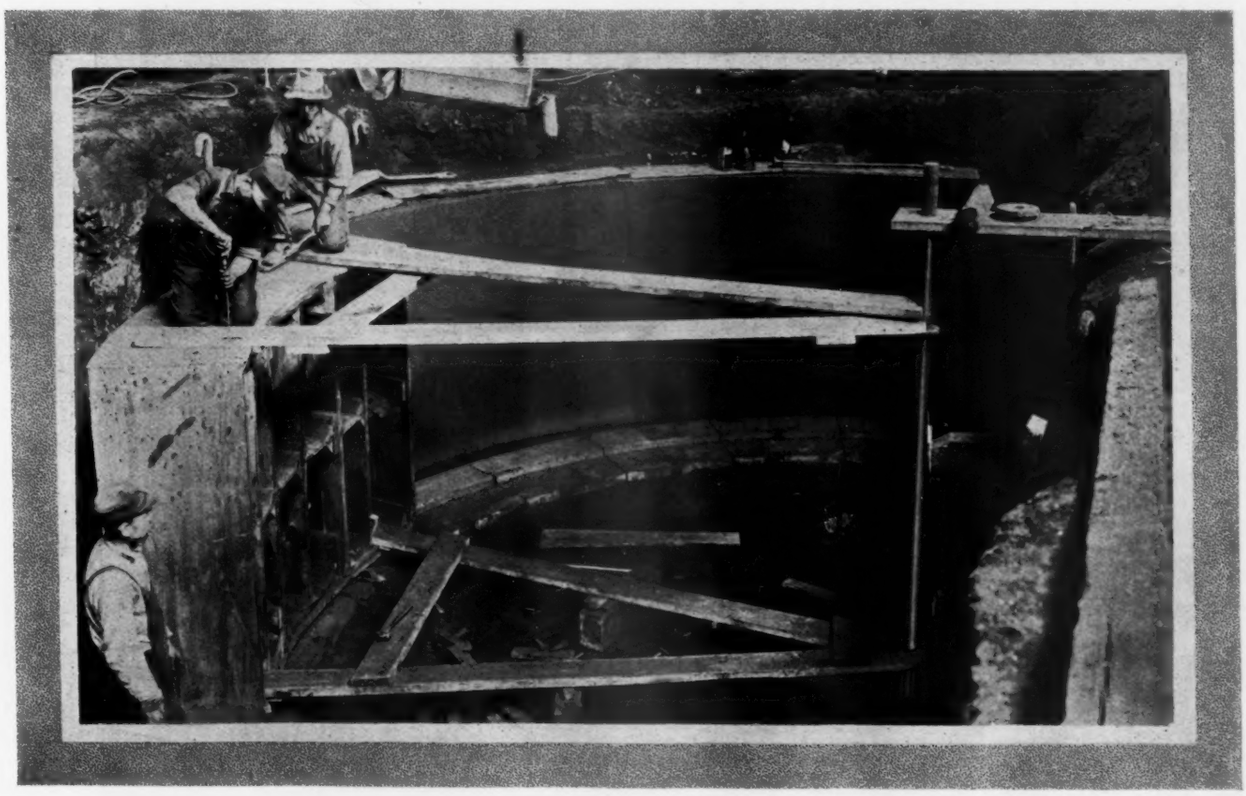

FIG. 1—MAKING A MOLD FOR A 26-FOOT GENERATOR FIELD FRAME

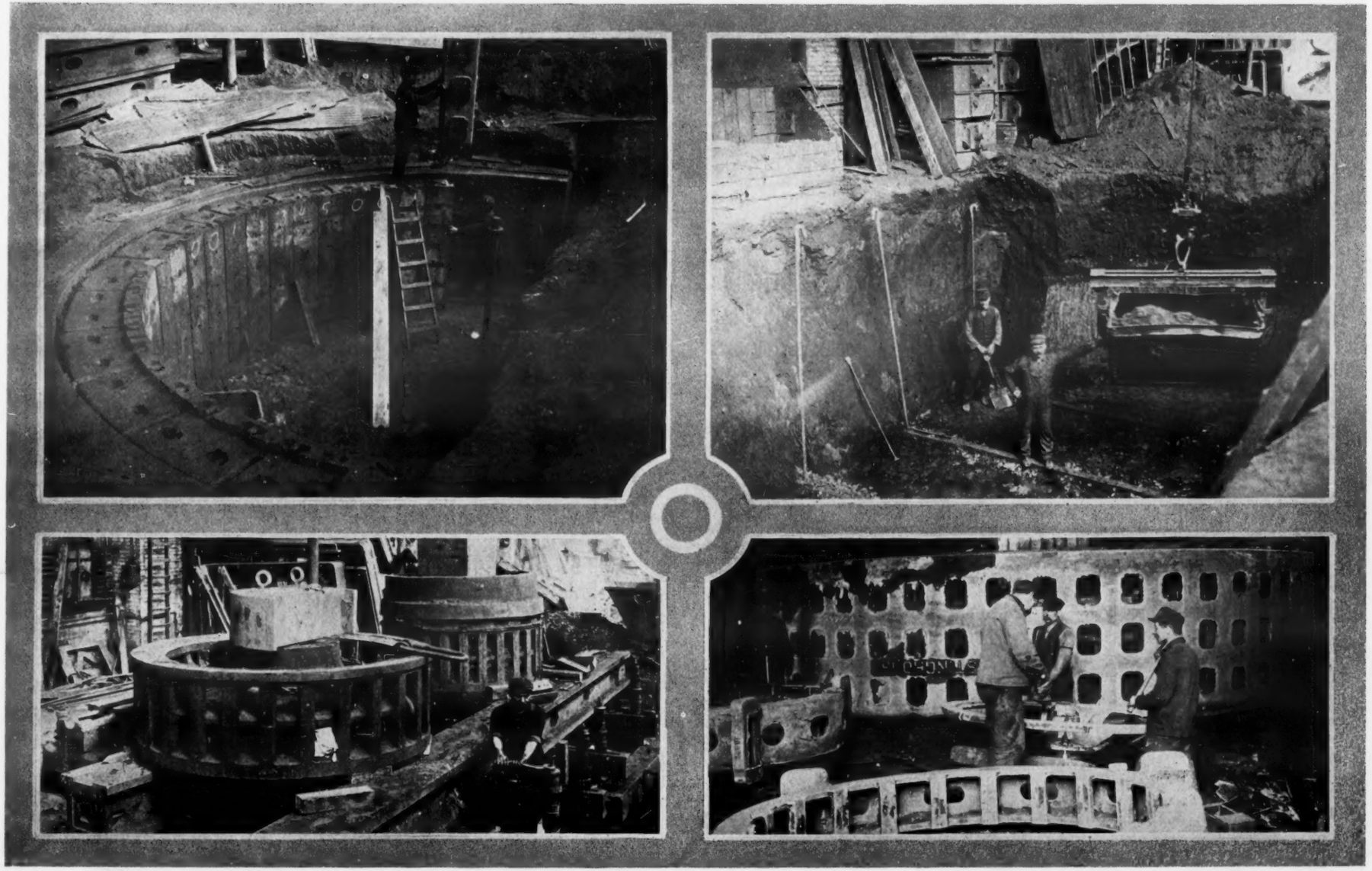

FIG. 2—SETTING THE LIGHTENING CORES
FIG. 4—BINDING AND WEIGHTING THE CASTING

FIG. 3—LAYING THE BINDERS IN THE BOTTOM OF THE PIT
FIG. 5—FIELD FRAME CASTING AS SHAKEN-OUT

rated at an overspeed of 86 per cent and are to have direct-connected exciters. The frames cast thus far have not been distorted and machined true to dimensions at the East Pittsburgh plant of the Westinghouse company. When making the molds, possible distortion was not considered as a factor in the final result, which indicates that the design was correct and that the casting was properly proportioned to prevent warping.

The molds are made in the floor in large pits with a segment pattern operating on a sweep spindle. One of the pits preparatory to making a mold is shown in Fig. 3. Six binders are imbedded in the bottom of the pit, recessed at either end for the anchor bolts, three of which are shown at the left of Fig. 3. On top of the binders, cast iron plates are laid and on top of this the bed for the mold is prepared. By the aid of the spindle shown in Fig. 1, the row of bottom cores is centered and set and on these cores the segment pattern is located when ramming the outside face of the mold. The back wall of the pit against which the outside face of the mold is rammed is supported by cast iron curbing. The arc of the segment pattern is one-twelfth of the circle, thus necessitating only six settings in completing the face. The sand is rammed between the face of the segment pattern and the curbing supporting the wall of the pit, the pattern being successively moved on its spindle until the entire face is rammed. After blacking the face, this surface of the mold is dried with a coke fire.

After the mold is dried, 28 cores are set to lighten the inside of the frames, as illustrated in Fig 2. The cores are lowered into position by a crane and rest on the bottom cores previously referred to. Heavy cast iron weights then are lowered into the pit to support the cores and to fill the space in back of them, sand being rammed around and between the weights. The mold is covered with dry sand cores, on top of which cast iron plates are laid. Binders are next placed in position over the cast iron plates, being located to correspond with the binders in the bottom of the mold. Through slots in the ends of these binders, hooked bolts are passed which engage the hooks on the ends of the anchor bolts attached to the bottom of the binders. By tightening the nuts on these top bolts, the entire mold is tied together. As an added precaution against lifting, cast iron channels are laid across the top binders and on top of these, heavy cast iron weights are set. A mold weighted in this way, before pouring, is illustrated in Fig. 4. In this view, a workman is shown tightening one of the anchor bolts.

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BRONZE MEMORIAL TABLET CAST FROM METAL RECOVERED FROM THE U. S. S. MAINE

Two pouring basins are built at either end of the mold, the metal entering at five gates. In one pouring basin three sprues are provided connecting with as many runners. The sprues are plugged and when the first pouring basin is filled the plug of the first runner connecting with the lowest gate is pulled out, followed by the withdrawal of the plugs of the runners connecting with gates at points successively higher on that side of the mold. The third plug is pulled when the ladle is about three-fourths empty and then pouring is commenced into the basin at the other end of the mold. The gates at this side of the mold enter respectively, 3 feet and 18 inches from the top, and when the basin is filled the plug is withdrawn from the runner connecting with the lowest gate on this side of the mold. By staggering the gates in this way, a constant stream of metal enters the mold and as the iron rises, another stream of metal enters from a gate located at a point higher than the previous gate.

The gates are 2½ inches in diameter and both runners and gates are fire brick. The runners are built-up of 6-inch sections and can be extended to any height. The use of fire brick for this purpose has proved exceedingly satisfactory and insures clean runners and gates without the usual risk of carrying sand into the mold. Each casting weighs approximately 41,000 pounds and a molder and helper require two weeks to make a mold. Before shaking-out, the casting is permitted to remain in the sand three days.

Maine Memorial Tablets

One thousand tablets now are being cast at the brass foundry of John Williams, Inc., New York City, from metal recovered from the U. S. S. Mains, destroyed in Havana harbor, Feb. 15, 1898. These memorial tablets will be distributed upon application, to patriotic societies throughout the United States. Thus far more than 200 applications have been received by the assistant secretary of the navy. The metal from which these tablets are being made consists of the copper, brass and bronze fittings of the battleship, which for 12 years lay submerged in Havana harbor. The metal is being forwarded to the Williams' foundry in the form of 30-pound ingots and thus far 6,000 pounds of metal have been received. It is probable that there will be sufficient metal to make 4,000 or 5,000 tablets. As shown in the accompanying illustration, the design is symbolic of patriotism and devotion. The tablets will have a natural bronze finish, will weigh 12½ pounds and are 13 x 18 inches in size. The tablet was designed by Charles Keck, New York.

Enameling Process for Cast Iron Sanitary Ware

Report of an Exhaustive Investigation of American Enameling Practice, Including Mixtures, Cost of Equipment, Operation, Etc.

By Nelson E Frissell

THE OWNER of every jobbing foundry, no doubt, at some time has considered a permanent article of manufacture, and it was this idea that prompted the proprietor of a progressive casting plant in the east to commission the writer to investigate the cast iron enameling industry of the United States. This study included not only the actual process of enameling, but cost data were secured from reliable sources on the smallest practical unit of manufacture, as well as the cost of enameling a unit area of cast iron. The availability and cost of the ingredients that are used to make enamel, together with a consideration of the class of labor necessary to operate such a plant, are of prime importance to the prospective manufacturer of enamel ware.

Enameled cast iron sanitary ware is much cheaper to manufacture than that made of solid porcelain. The fundamental value of cast iron as a base for porcelain enamel is due to the fact that it gives a rigid support. Enamel is really a white, opaque glass, having the properties of the latter. A good enamel should have the same coefficient of expansion as cast iron. It is apparent that if this were not so, the expansion of the iron due to a change in temperature would put the glass coating in tension and fracture would result. The iron also takes up all other stresses, especially those of bending.

The Enamel

For years the ingredients of the enamel were secret and, of course, the exact mixture is considered a big asset by each company engaged in this line of work. The compounder usually is a member of or has an intimate connection with the firm. The actual mixing and making of the enamel requires considerable manual labor and this is accomplished by unskilled workmen.

Let us suppose that the enamel is made of 10 different minerals or chemicals, which we will term *A*, *B*, *C*, *D*, *E*, *F*, *G*, *H*, *K*, *L*, respectively. We will assume, for example, that there are five parts by weight of *A*, 20 of *B*, 13 of *C*, 12 of *D*, 6 of *E*, 13 of *F*, 6 of *G*, 10 of *H*, 5 of *K*, and 10 of *L*. For every 100 pounds of mixture the compounder, in his private laboratory, takes 5 pounds of *A*, 6 of *E*, 6 of *G*, and 5 of *K*, mixing and manipulating the batch to his own satisfaction. He gives this material to the workman, who completes the list of ingredients in their respective amounts. The compounder thus is spared the heavy work and he knows that the more costly and important materials are used in their correct proportions and are not wasted. In other words, he holds the key of the situation without an undue amount of manual labor and

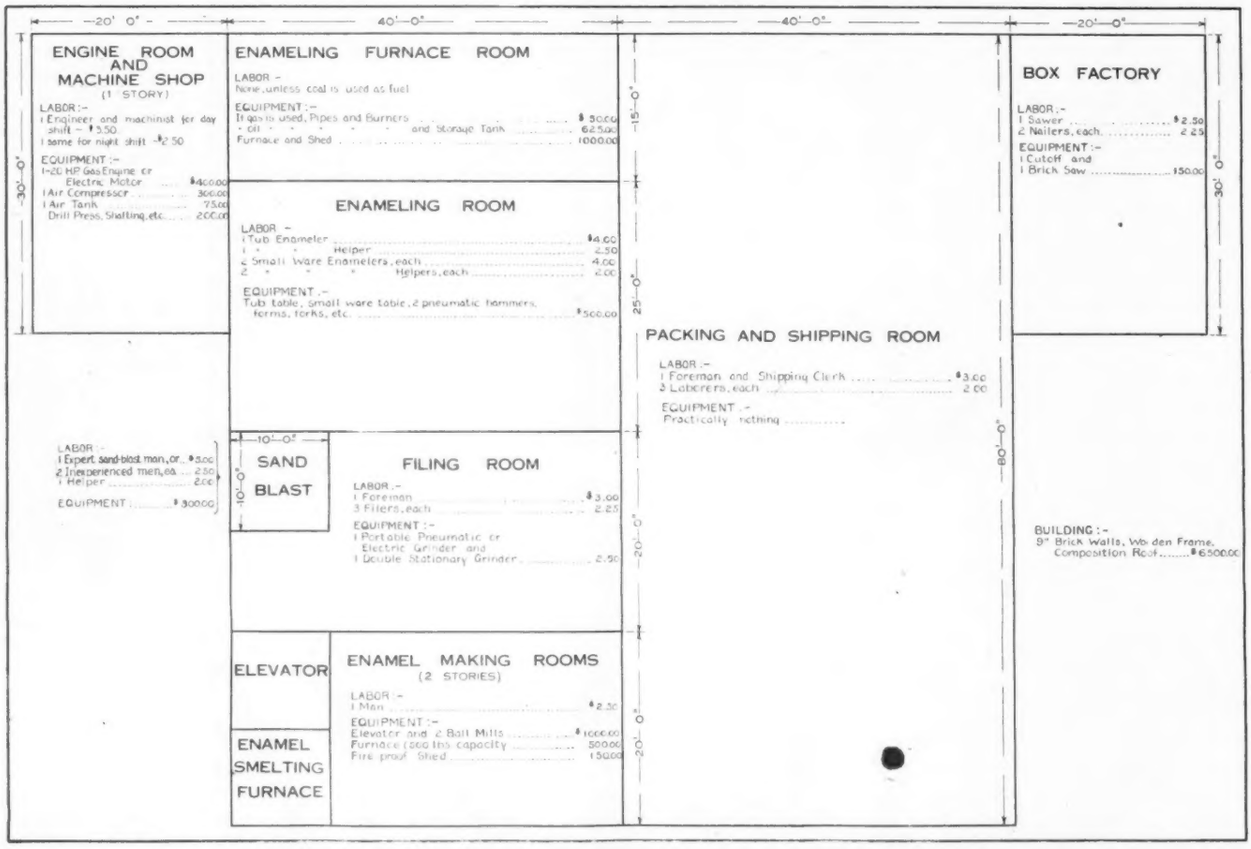

FIG. 1—PLAN OF A ONE-STORY ENAMELING PLANT, INCLUDING ITS EQUIPMENT AND COST. THE OUTPUT IN 24 HOURS IS PLACED AT 16 TUBS AND 75 PIECES OF SMALL WARE, INCLUDING SINKS, ETC.

tedious work. This is a satisfactory solution of the enamel mixing problem for the superintendent of a small concern.

A successful mixture is obtained only after careful study and experiment. The same formula is not adapted to all work, because of the various types of smelting and muffle furnaces employed, the different methods of applying the enamel, the kind of metal used as a base and the chemical constitution of the available materials. When a good mixture has been obtained, it is of the utmost importance to continue using, as far as possible, the same minerals from the same sources of supply. If it is necessary to change the sources of supply, the compounder should test the new material chemically and he should enamel a number of small test pieces with his new mixture until he has a satisfactory coating.

A number of cast iron test pieces should be made similar to the one shown in Fig. 2. This piece has all the surfaces encountered in the manufacture of sanitary ware. It includes the roll rim of a bath tub, vertical and horizontal surfaces and a sharp corner.

Basis of the Mixture

Since enamel is a form of glass, it must be apparent that sand or silica is the basis of the enameling mixture. Ordinary glass is a silicate of potassium and sodium, and enamel is a silicate of metallic oxides with an excess of silica. Ordinary sand is silica, but impurities, chiefly iron, give it color. Sea sand also contains iron. Flint, quartz and agate also are forms of silica. The most important sources of glass sand supply in the United States are in the states of Massachusetts, Illinois, Missouri, New Jersey, Ohio, Pennsylvania and West Virginia.

In enamel-making, we are concerned with the insoluble silicates; for example, an insoluble silicate is produced by fusing four parts of sand with one part of alkali, soda or potash. In other words, an excess of silica is used. The contradistinction is a production of the silicate soluble in water and known as water glass by the addition of one part silica to five parts of potash boiled with water.

Clay is used in most formulae and since crockery is composed of sand, lime, clay and magnesia, the silica uniting with these minerals, we may have ambiguous deductions. However, the amount of sand in crockery is small as compared to the other constituents. A discussion of the office of clay in enamel will follow, showing that clay is not used for the silica it contains.

It will be well to note some of the properties of silicon dioxide that are of importance in enamel-making. It requires the temperature of the oxy-hydrogen blow-pipe flame (2,844 degrees Cent.) to melt it; silicon dioxide is insoluble in water and in all acids except hydrofluoric. As previously stated, it dissolves in alkalis by the application of heat, also in a boiling solution of sodium carbonate.

Feldspar

Feldspar, as its formula, $Al_3 K_2 (Si_3 O8)_2$ indicates, gives body to the enamel, it being a trisilicate of aluminum and potassium. A good feldspar is nearly colorless and has a composition of 65

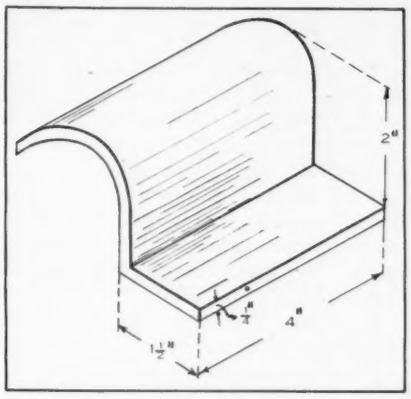

FIG. 2—TEST PIECE FOR CAST IRON ENAMELING

per cent silica, 19 per cent aluminum and 16 per cent potassium. Feldspar is mined in California, Connecticut, Maine, Maryland, Massachusetts, Minnesota, New York, Pennsylvania, Vermont and Virginia.

Borax is as common to enamel formulae as sand. Crude sodium borate contains sodium, boron, oxygen and water of crystallization according to the formula, $Na_2 B_4 O_7 7H_2 O$. Borax is used to cleanse the surface from rust or other metallic oxides and foreign substances, and also is employed as a fluxing agent. Foreign particles destroy adhesion in any coating process and borax is used to reduce them. When heated, borax swells and loses its water of crystallization, thus aiding chemical reaction and producing a fusible mass. Since it contains water of crystallization, an excess of borax used in enamel will absorb water in the finished coat, resulting in a loss of luster and imparting an undesirable, dull finish.

Sodium Carbonate

Washing soda is sodium carbonate, $Na_2 CO_3 10H_2 O$. The large, transparent crystals of this material disintegrate to a powder when exposed to the air due to the loss of some of the water of crystallization. When heated, the sodium carbonate gives off its carbon dioxide, CO_2, and leaves sodium dioxide, a low temperature flux. This substance reduces the melting temperature of the mixture and imparts elasticity. An excess of sodium oxide causes *crazing*, which consists of a multiplicity of fine, hair-like cracks in the finished surface of the enamel. Crazing also is produced by impurities such as sulphur. The latter occurs most frequently in the fuel used and if it has access in any way to the enamel, considerable trouble will be experienced. Sodium oxide does not absorb sulphur as readily as some of the other fluxes.

Cryolite occurs as a double fluoride of aluminum and sodium, $Al_2 F_6 6NaF$. Its use is as a fluxing agent and it has a tendency to make the enamel opaque. Cryolite is found on the southern coast of Greenland.

Fluorspar is the mineral, calcium fluoride (CaF_2) and its use in enamel is as a flux. When melted, it does not unite readily with other substances, but it seems to act as a medium in which reactions take place. Fluorspar is mined in Illinois, Kentucky, New Mexico and Colorado.

The common paint pigment, red lead, is valuable in enameling, because it is a metallic oxide, $Pb_3 O_4$. In enamel it serves as a low temperature flux, reducing the melting point of the mixture. Since it imparts elastic and malleable properties to the mixture, it has a tendency to reduce crazing or cracking. If a slight amount of carbon is present, due to the presence of dirt in the baking furnace, it causes the oxide to be reduced to metallic lead. These lead particles show up in the mixture as fine specks. To obviate this difficulty saltpeter is added.

Saltpeter

An amount of saltpeter, KNO_3, equal to perhaps 2 per cent of the mixture, is added as an oxidizing agent to prevent the reduction of the oxides to the metallic form. Saltpeter and limonite, or manganese dioxide, act as decolorizing agents, due to their oxidizing powers. Saltpeter is imported from Chili and manganese ore is mined in Arkansas and Virginia.

Oxide of magnesia is used on account of its refractoriness and hardening properties. The only state that produces magnesite ore is California and a large tonnage is imported.

Clay is used principally for its binding properties. It binds a wet mixture and during the grinding operation, a process which will be described later, the clay present holds the enamel in suspension, due to the finely divided condition in which the clay exists. It should be noted that it is added after the fusion of the material used to make the enamel, and it is not employed to give body to the enamel nor as a fluxing agent. All organic matter should be removed from the clay by soaking it in

water for 48 hours at room temperature and then boiling. Clay is found in most every state.

Perhaps the most important constituent of enamel is tin oxide. This expensive material imparts the lustrous, opaque white finish to enameled ware. Manufacturers have spent a great deal of time and money trying to find a substitute for this expensive chemical, but thus far they have been unsuccessful. Tin oxide is ground with the materials constituting the finish coat.

Ammonia is added in the form of ammonium carbonate. The first thought is, of course, that the ammonia is driven off by heating and is, therefore, a useless expense, since an amount equal to 3 per cent is often used in the finish coat. It is a question whether this ingredient makes the enamel uniform and prevents cracking.

It is highly important that the water used in enamel-making is soft and free from organic matter. The metallic oxides are added to lower the melting point. Heated, the acid properties of the silica are developed and help drive out the carbon dioxide and water of crystallization in the different materials. At the same time attention must be paid to the amount of sodium and potassium used in the different materials, as these make the glass, in other words, the sodium and potassium silicate. The addition of a fluxing compound containing sodium lessens the amount of another compound required and containing sodium.

Cost of Materials

The estimated cost of melted enamel varies from 6 to 8 cents a pound. If one carefully studies the different materials and their functions, it may be possible to reduce the cost of the enameling mixture by increasing the proportion of the less expensive ingredients. Tin oxide, however, is without a good substitute. The costs per pound of the materials used in the enameling mixture follow:

	Cost per pound.
Tin oxide	$0.40
Feldspar	0.004
Flint	0.004
Fluorspar	0.005
Borax	0.035
Boric acid	0.045
Barium fluoride	0.035
Soda ash	0.009
Sodium nitrate	0.033
Pearl ash	0.080
Potassium bicarbonate	0.02
Potassium nitrate	0.053
Red lead	0.063
Manganese deoxide	0.043
Bone ash	0.063
Zinc oxide	0.060
Cryolite	0.063
Whiting	0.006

There are two coats of different constituents used in covering cast iron, the gray or ground coating being followed by successive deposits of the finish or white coating. The gray coating must expand and contract with the iron and is fused into the base metal at nearly a white heat. A ground coat may be defined as a thin, transparent glaze applied to cast iron articles, not only to act as a bond between the iron and the white, opaque enamel, but to prevent the oxidation of the iron while it is being raised to the temperature at which the white enamel fuses. The ground coat has a little higher melting point than the white coat and therefore is unaffected by the successive firing of the finish coat.

The Ground Coat

The ground coat should be free from sulphur or other injurious elements, as impurities work havoc in the best proportioned mixture. It should dissolve any oxide of foreign matter on the surface of the metal. A clean surface for the ground coat is essential, as it cannot absorb much rust or facing.

It should have low viscosity, as a free flowing mass is necessary to impart a smooth surface. Inequalities in the thickness of the ground coat cannot be covered with the finish coat.

The ground coat should begin to fuse at a dull red heat.

The raw materials are stored in metal-lined bins and the contents should be designated, as some of the minerals are similar in color. The required amounts are weighed by a portable scale, which is moved from bin to bin. A batch of enamel never exceeds 400 pounds and it is mixed in a metal-lined box. After riddling the enameling mixture through fine sieves it is smelted in a furnace, generally of the blast type, at a temperature of about 1,200 degrees Cent. Success depends on a vigorous stirring and mixing. The duration of this process is approximately 2 hours or until the cooled enamel shows a bright, absolutely smooth surface and a fracture free from porosity. The molten enamel is run into cold water to disintegrate it, after which it is delivered to the mills for grinding.

Pebble mills or weighted iron rollers are used for grinding. The amount of fused enamel in a grinding charge varies from 50 to 75 pounds and the time required to grind the material varies from 4 to 10 hours, according to the desired fineness desired. Water is added to reduce the heat generated in the grinding process.

Enamels for both the ground and finish coats are smelted in the same furnace and are ground in the same mill. The ground enamel is considerably more moist than the white and is run off as a liquid from the mill, being allowed to stand a few days before using. White enamel is dried in covered pans placed on top of the furnace.

A formulae for a ground coat, which has given excellent results, follows: Sand, 44 pounds; borax, 18 pounds, and saltpeter, 14 ounces. This mixture is fused and then is ground with an addition of 9 per cent by weight of quartz and 12 per cent of clay.

A formulae for a finish coat follows: Feldspar, 39 pounds; sand, 31 pounds; borax, 31 pounds; soda ash, 24 pounds; fluorspar, 9 pounds; whiting, 4 pounds, 9 ounces, and zinc oxide, 6 pounds.

This is thoroughly fused and mixed and then is ground with 14 per cent of tin oxide, 7 per cent of zinc oxide and 7 per cent of clay. It is important that the tin oxide be not added until this stage. It is the belief of the writer that the best way to obtain a satisfactory enamel is to experiment with the materials named, in the above proportions.

As regards the constituents of the castings, little need be said except that an excess of graphitic carbon must be avoided. This carbon, since it is not combined with the iron, is on the surface in the form of small crystals. Iron high in graphitic carbon does not possess the desired clean metallic surface necessary for a bond between the base and the ground coat.

Applying the Enamel

By far the most satisfactory method of cleaning castings is by the sand blast process. If pickled, the castings are dipped into dilute acid, subsequently being heated to redness to remove any adhering foreign matter. The castings are heated to a temperature of about 750 degrees Cent. (1,182 degrees Fahr.). For pickling, dilute hydrochloric acid, proportioned one-third acid and two-thirds water, is used. Sulphuric acid, one-tenth, and nine-tenths water, can be used, but care must be exercised in using this pickle. Some German firms use dilute hydrofluoric acid, because it dissolves the more deeply imbedded sand particles. It is essential that a workman test the pickle daily by comparison with a soda solution.

The most suitable vessels for pickling are asphalted wood tanks lined with lead. The object is suspended in the tank by a latticed basket and is allowed to remain for 30 to 50 minutes, except in cases where a considerable coating of rust has formed. After pickling, the ware is washed and scrubbed with wire brushes and plenty of clean water. Any remaining acid is removed by dipping in a boiling soda solution or in milk of lime. The ware is again washed followed by a quick drying.

Success in enameling is dependent fully as much upon the application of the enamel as on a good mixture. The ground enamel is called soup, as it contains one-third water. It is applied with a dipper or spray, the latter method being more economical and insuring a

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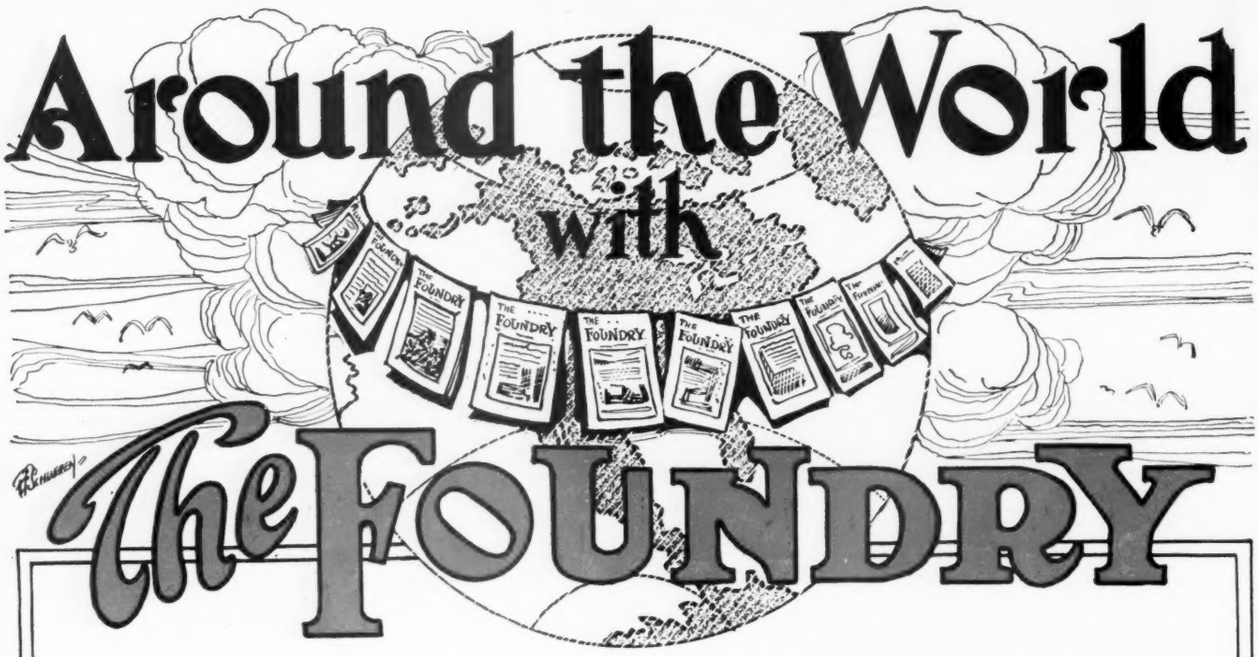

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more uniform coating. The casting is rocked back and forth to insure an even surface and is dried quickly over steam pipes or by the hot, waste gases from the furnace. Inequalities in the surface and fine holes are retouched.

A skillful workman can ground-coat from 200 to 300 large pieces, such as bath tubs, in a day of 10 hours. No thickness for a ground coat can be recommended, but as a rule it is equal to approximately 10 per cent of the weight of the casting.

The finish coat is applied either as a liquid, or a dry powder. If liquid, it is applied by means of a dipper and the object is rocked as in ground coating. The dry method consists in sifting onto a revolving or stationary object the white powdered enamel by means of a mechanical sifter. This sifter consists of a sieve agitated by a pneumatic vibrator, placed on the end of a handle. By the use of the sifter the workman suffers less discomfort from the heat and a more uniform coating is assured.

Firing the Ware

A muffle furnace, heated to a temperature of 1,000 degrees Cent. (1,800 degrees Fahr.) for ground-coating and 850 degrees Cent. (1,130 degrees Fahr.) for the white finish coat, is required. A casting having received its coat of gray is placed in the heated muffle by a specially designed crane, the door of the furnace being operated by compressed air. A small lavatory requires 4 to 5 minutes for burning-in the ground coat. A bath tub causes a considerable lowering in the temperature of the furnace and, therefore, requires a longer time.

When thoroughly burned, the object is taken out, and if small, is placed on a pedestal or table that can be revolved. It is at this point in the operations that the white coats are sifted on the red hot surface after successive firings. The time required for a firing varies from 12 to 20 minutes, according to the size of the object. Large ware, such as bath tubs, are allowed to cool slowly in a specially constructed chamber and small ware is cooled in the open air.

A temperature greater than 900 degrees Cent. for the finish coat is injurious, as it causes the tin oxide to partly dissolve, forming tin silicate; therefore, since the coloring quality of the tin oxide is due to the finely-divided state in which it exists in the molten enamel, the temperature of the furnace must be properly regulated.

In most plants the heat is regulated by watching the color of the ware, but it would be far better to record the temperature with a pyrometer. With such an instrument the correct temperature for each size and kind of object could be observed and maintained.

The unit cost of ware varies widely according to the cost of enamel, percentage of defective ware, skill of workman, etc. The cost of enameling tubs is 12½ cents per square foot and for small ware, such as lavatories, it is 20 cents per square foot. A 200-pound bath tub with over all dimensions 2½ x 5 x 2 feet would have approximately 40 square feet of enameling surface and the cost of enamel would be $5.00.

In every industry the availability of energy is a vital factor. The heat in enameling works is supplied with one of the following fuels: Natural gas, fuel oil, coke or coal, named in the order of their respective merit. Natural gas is the best fuel that can be employed and the heat supply is more easily regulated when gas or oil is used. Fuel oil is, of course, more liable to burn out the fire brick and deposit paraffine in the pipes. Coal-fired furnaces are not so easily regulated and an extra man is required for firing.

In a muffle furnace the heat losses are great and the writer believes that the use of a semi-muffle furnace fired with oil at low pressure, is entirely feasible. In a furnace of this type the combustion chamber is underneath the heating chamber and the hot gases rise through slots in the floor at the sides of the heating chamber. This prevents dirt and harmful products from coming into contact with the work.

A small plant would require a fuel oil muffle furnace, 32 inches wide, 72 inches long and 28 inches high at the spring of the arch; also a rotary blower, rated to pump 293 cubic feet of air per minute when running at 375 revolutions. The shaft of this blower is fitted with a sprocket wheel, from which an oil pump is driven. The blower delivers air to the distributing pipes for the burners at a pressure of two pounds per square inch. A uniform pressure is maintained, notwithstanding a variation in the number of burners in use.

The ½-inch rotary oil pump driven from the blower shaft is geared to operate at 70 revolutions per minute and delivers oil into the distributing pipes at a uniform pressure of four to five pounds per square inch. Surplus oil discharged by this pump passes back to the storage tank. With the pump and air compressor connected it is impossible to discharge unatomized oil into the furnace. This outfit would require a tank 35 feet long and 7 feet in diameter, holding 10,200 gallons of oil.

Fig. 1 contains a plan of a one-story plant for enameling cast iron and shows the cost of equipment, labor and other data. The cost of a plant and its equipment is summarized as follows:

Sand blast room	$300
Filing room	250
Engine room and machine shop	975
Enameling furnace	1,000
If oil is used as fuel	625
Enameling room	500
Packing and shipping room	no estimate
Box factory	150
Enamel-making room	1,650
Buildings, brick	6,500
Total	$11,950

The labor cost and the number of men required are indicated in the accompanying table.

The output of such a plant would be 16 bath tubs and 72 pieces of small ware, such as lavatories and sinks, in 24 hours. A description of the manufacture of sanitary ware was published in THE FOUNDRY, March, 1919, to June, 1910. Another source of information estimates the cost of a one-furnace plant at $10,000. The number of men required to run the plant is placed at 10, which includes only the enamelers. Their rate of pay is figured at 50 cents an hour and helpers at 25 cents. The item of fuel cost per furnace per month varies from $100 to $150, according to this manufacturer, natural gas being used. The enameling of cast iron involves many difficulties. The work requires careful attention and failure can be traced to many causes.

Labor Cost.

	Men.	Per day.
Sand blast room, 2 men at $2.50, 1 at $2 a day	3	$ 7.00
Filing room, 1 foreman at $3 and 3 filers at $2.25	4	9.75
Engine room and machine shop, 1 engineer at $3.50 and 1 for the night shift at $2.50	2	6.00
Enameling room, 2 shifts, 2 enamelers (tub) at $4, 2 helpers at $2.50, 4 enamelers (small ware) at $4, 4 helpers at $2	12	37.00
Packing room, 1 foreman at $3, 3 laborers at $2	4	9.00
Enamel-making room, 1 laborer at $2.50	1	2.50
Totals	26	$71.25

Molding Sand for Panama

Molding sand for use in the government's steel foundry in Panama is being shipped from New Jersey. It is stated that 5,000 tons are now being mined in the Old Fountain Woods tract near Burlington, N. J., preparatory to shipment by rail to New York and thence by steamer to the Isthmus. The sand on the Isthmus is not of proper quality for steel casting manufacture, and it has been found necessary to import the material from this country.

Making a Large Vanadium Bronze Engine Housing

A Description of the Method of Molding and Casting, With Details of the Pouring Basin, the Use of Plugs in the Gates, Etc.

THE Vanadium Metals Co., Groton, Conn., makes a specialty of casting vanadium bronze bed plates and housings for Diesel marine engines. These castings are manufactured for the New London Ship & Engine Co., of Groton. Many difficulties were experienced by the Vanadium company when it first began to produce these intricate and heavy castings several years ago and considerable special rigging and ingenious molding methods had to be adopted before these castings were successfully made.

An aft section housing for a 450-horsepower marine oil engine of the Diesel type, as shaken-out of the sand before cleaning, is illustrated in Fig. 5. It will be noted that the casting is of box section and contains numerous cored openings. This casting is rammed in a flask, 51 x 80 inches, the drag and cope halves being 33 and 12 inches deep, respectively. The pattern is entirely in one piece and is rammed in the drag, the cope merely serving as a cover.

Making the Mold

When ramming the mold, sand to a depth of about 4 inches is rammed next to the pattern, upon which 4 inches of cinders are rammed for the purpose of venting. The remainder of the pattern is filled with heap sand. The mold is unusually well reinforced with rods and gaggers. Owing to the high shrinkage of the metal used for casting this mold, bronze chills are rammed in position over flanges and other heavy sections of the casting. This practice has eliminated shrink-holes and the drawing of the metal from the lighter to the heavier sections.

The cope which serves merely as a cover is well barred and is rammed on top of the drag. To insure ample venting, cinders are used extensively in the cope in the same manner as in the drag. On top of the cope a frame is built which contains the pouring basin, dry sand riser cores and the six sprues through which the metal enters the mold.

This frame, in position on the cope, is illustrated in Fig. 2. Dry sand cores form the termination of the eight risers

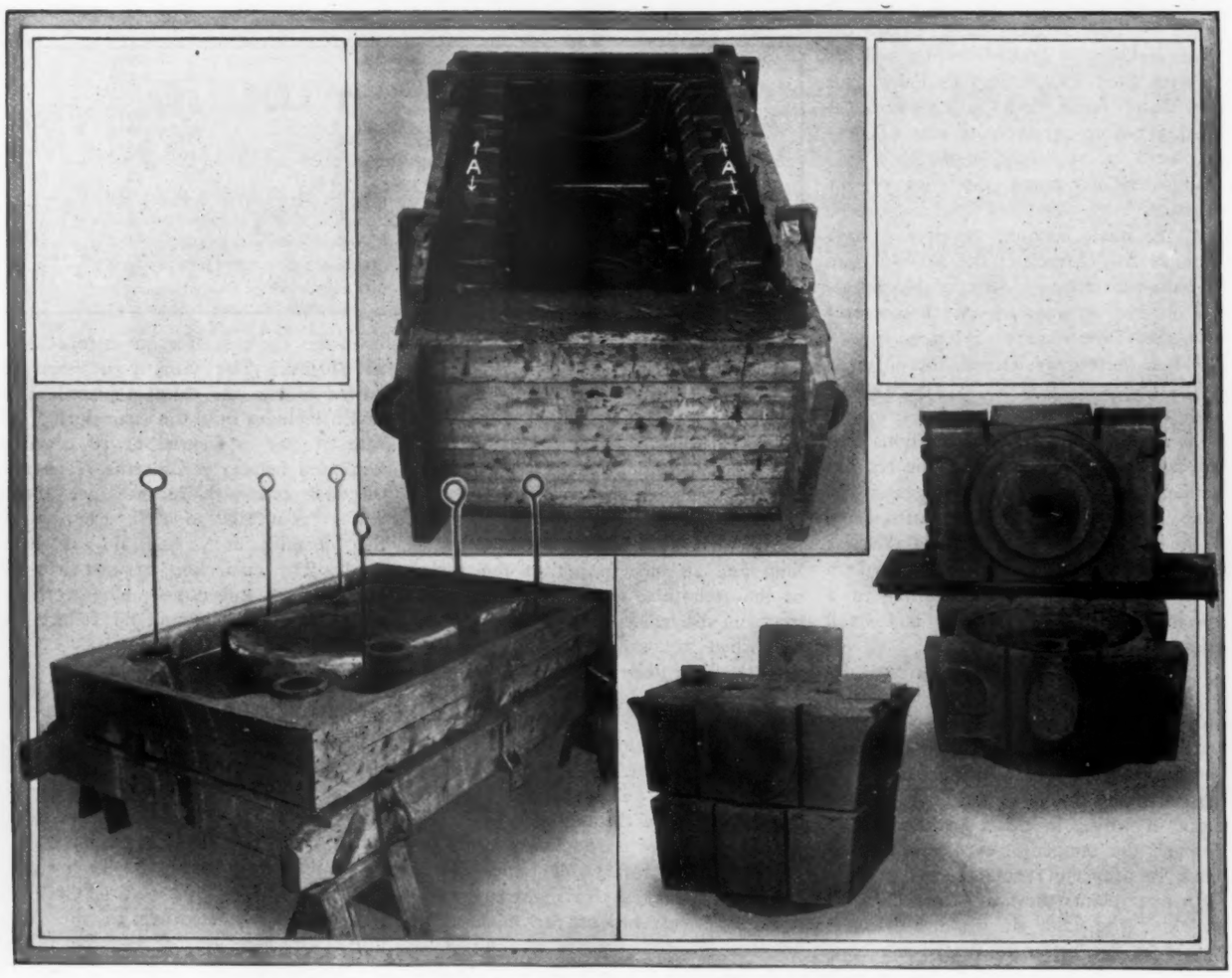


FIG. 1—DRAG HALF OF MOLD, SHOWING FOUR TEST LUGS AT *A*

FIG. 2—FRAME CONTAINING POURING BASIN AND DRY SAND RISER CORES

FIG. 3—SEVERAL OF THE LARGE CORES ASSEMBLED

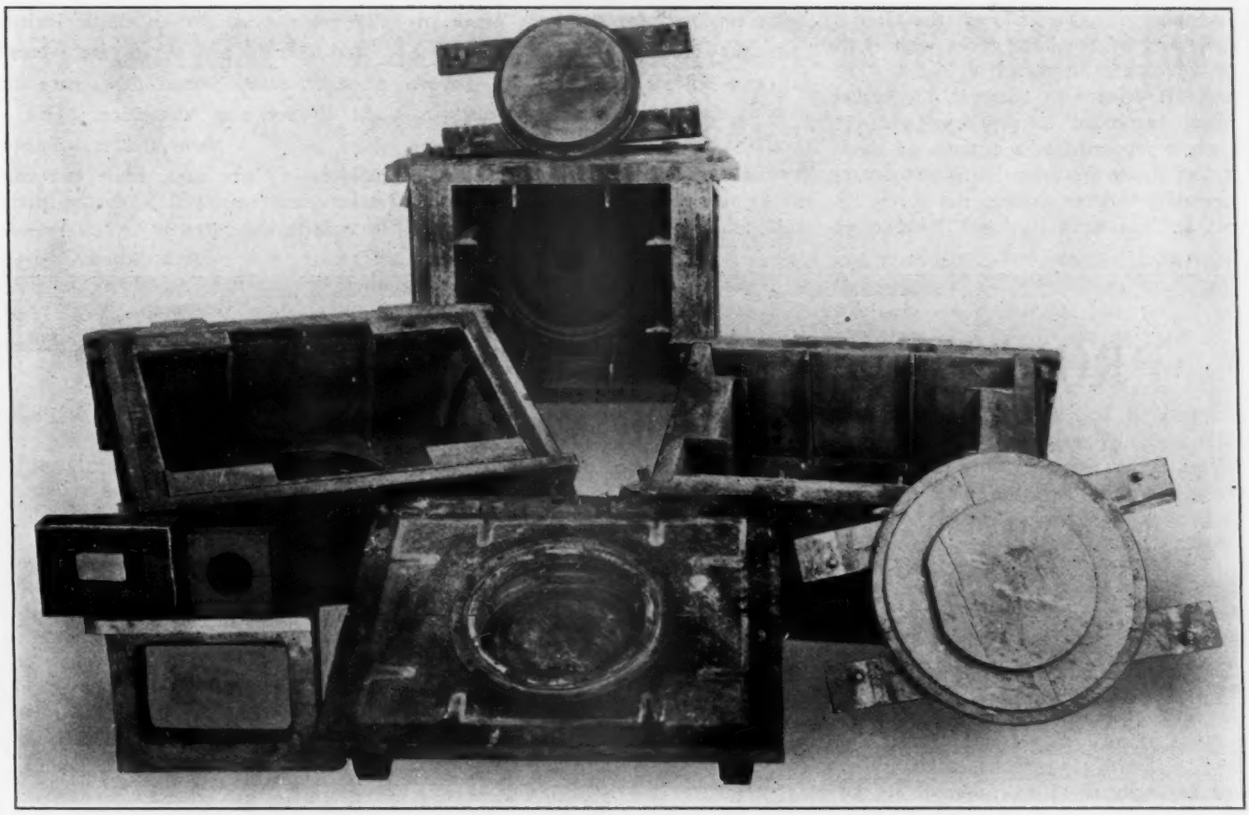


FIG. 4—CORE BOXES FOR CORES REQUIRED FOR DIESEL ENGINE HOUSING MOLD

and extend through the rammed sand of the frame connecting with the upper openings of the risers in the cope. The pouring basin is molded in this frame, as illustrated in Fig. 2, and in this view the six sprues are shown, which lead into the top of the drag, where they connect with two gates that extend the length of the mold on either side. From the gates nine feeders lead into each side of the mold, as clearly shown in Fig. 1. When pouring the mold, the basin, Fig. 2, first is filled with metal from the crane ladle, after which the six sprue-hole plugs are pulled out. This permits the metal to enter the mold from the sprues simultaneously and under uniform pressure. After casting, the surplus metal is drained from the basin into a pig bed at the side of the mold by withdrawing

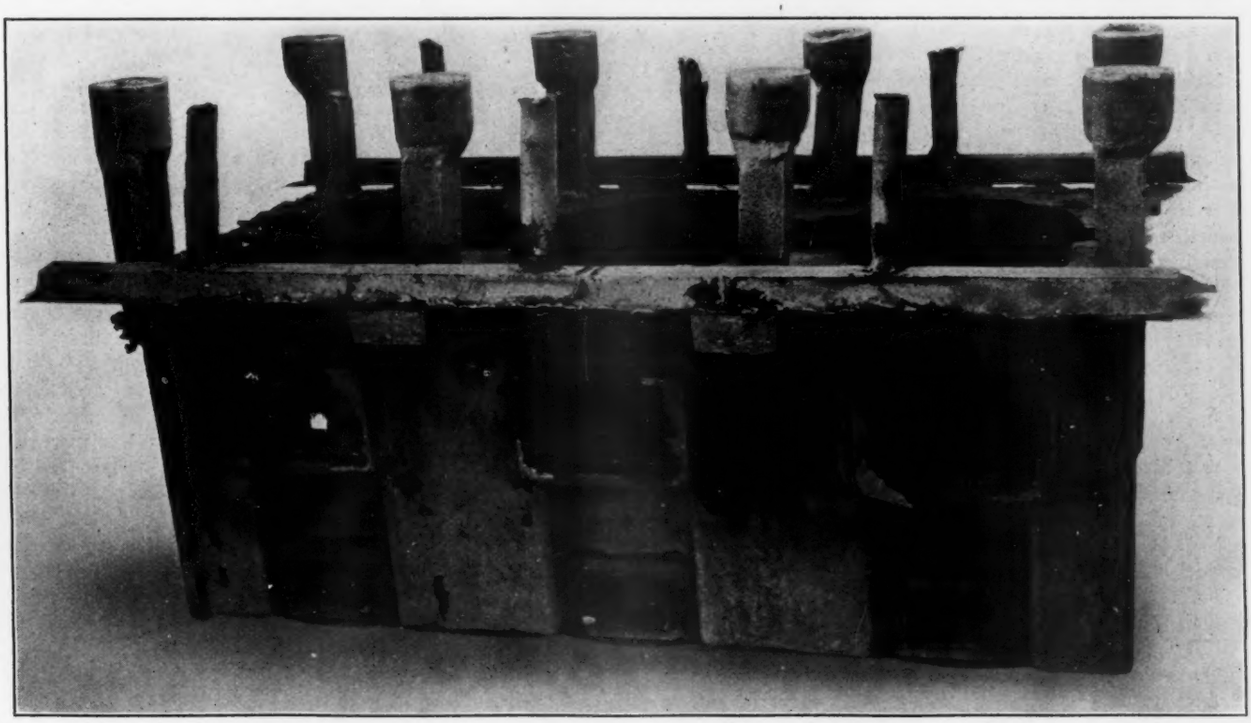


FIG. 5—HOUSING CASTINGS BEFORE CLEANING, SHOWING THE EIGHT RISERS AND SIX SPRUES

the plug in the end of the frame.

Several of the large cores with chills imbedded are illustrated in Fig. 3. The mold is dried with charcoal, the basket being suspended in the drag and the cope is supported at a distance of about 4 feet above the drag during the drying operation. After drying, the cores are set and the mold is closed, turnbuckles being employed for clamping, which engage the braces extending across the top and bottom of the flask. Before pouring the mold, a test bar is cast; the condition of the metal being judged by fracture. Four test lugs are cast in chills inserted in the drag half of the mold, as shown at *A*, Fig. 1. The specifications provide for an elastic limit of 30,000 pounds per square inch, tensile strength, 60,000 pounds per square inch and 20 per cent elongation. One of these molds is made and cast by two molders in three days, while two coremakers are employed a similar period in making the cores.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Melting Type Metal

We make stereotype metal from the following mixture: Lead, 80 per cent; tin, 6 per cent, and antimony, 14 per cent. Our linotype mixture contains lead, 82 per cent; tin, 4 per cent, and antimony, 14 per cent. We would like to have you pass upon the following method of melting: A part of the lead is first heated to redness, after which the antimony is added, followed by the balance of the lead. The metal is allowed to cool slightly and the tin is added. If there is a better method we would be pleased to have you advise us.

No improvement can be recommended in the manner of making these alloys. Lead volatilizes at a red heat, but the loss of this metal is unimportant, as it is necessary only to superheat a sufficient amount to dissolve the antimony, after which the temperature of the bath can be reduced quickly by the addition of cold lead. Theoretically, because of its higher melting point, antimony should be melted first, but if this mode of procedure is followed, considerable antimony will be lost by volatilization. For this reason it is the better plan to superheat a portion of the lead and to dissolve the antimony therein. Tin, having the lowest melting point, always should be added last.

Burning-In Brass

I desire to obtain some information regarding the burning-in of brass castings with a view to finding out the merits and disadvantages of this method. Some of the members of the firm with which I am associated are inclined to condemn this process, and I wish to convince them that a casting so treated is satisfactory.

"Prevention is better than a cure," is an old saw and this constitutes an answer to this query. A casting that has been burnt-in is never as good as one that required no such treatment, and this process is merely a method of patching defects. On many castings it is not economy to attempt to repair them by the burning-in process, because they can be recast more quickly and with a lower loss of metal. If a large casting contains defects which can be remedied by burning-in, such treatment is justified and if skillfully accomplished, makes the casting practically as sound as though no defect had existed.

The disadvantages of the process are that the burn may be deceptive, that is, when it is machined, the surface may be sound, yet underneath a considerable cavity may exist. Usually, however, a burn that appears sound is good, although when gas is created the blow-holes are visible when the surplus metal is removed. The burning-in process has been discredited, however, owing to the imperfect repairs that have been made in this way. A blow-hole is more difficult to burn than a sand hole. To insure the proper filling of the former, the entire cavity should be chiselled out, dusted with borax and the metal should be hot when poured therein.

Cleaning Non-Ferrous Articles

Articles of brass and copper with soldered joints or work consisting of lead, pewter or other soft metal, require greater care in cleaning in caustic solutions than either iron, steel or silver. For this reason, a mild alkaline solution is preferable. As there are compounds on the market which produce a solution in which soft solder, lead, pewter or any other soft metal, including aluminum, may be boiled for any reasonable time without attacking the metal, the plater who experiences trouble in this respect, is advised to try them. In many cases, these compounds have greatly changed the entire system of preparatory treatment of soft metals, and their solvent properties, in respect to both mineral and animal fats and oils, is remarkable.

Casting Aluminum

We are manufacturing light aluminum castings of uniform thickness and we would like to know what kind of sand is best adapted to this work. Is it necessary to use risers, and if so, how large should they be? Some of our castings develop pin-holes underneath the surface and occasionally they have soft and spongy spots. The mixture we are using consists of 5 pounds of copper, 85 pounds of aluminum and 10 pounds of zinc. Chloride of zinc is used for fluxing the metal.

A very fine grade of sand is necessary to produce high grade aluminum castings. Sand suited for this work can be purchased from any of the sand shippers or supply houses advertising in THE FOUNDRY.

Risers are not always necessary on thin castings, but whether they should be used or not is a question for the molder to decide, as it is impossible to give any advice on this point without having an opportunity to inspect the castings. As a rule, plain shapes of uniform section require no risers, and when bosses occur in the center of thin sections, shrinkage at such points can be controlled by placing pieces of brass or copper on top of the bosses, which are rammed up with the molds and serve as chills to cool the heavy sections quickly.

Pin-holes are caused by overheating the aluminum. The copper should be added in the form of a hardener consisting of 50 per cent copper and 50 per cent aluminum. This hardener is made by melting the copper under charcoal and adding the aluminum, the latter preferably being added in the molten state. It is poured into the copper slowly, the mixture being constantly stirred.

The mixture employed is a good one, but is rather more difficult to cast than an alloy consisting of aluminum, 92 per cent, and copper, 8 per cent.

An Intricate Bronze Casting for a Submarine

How the Mold Was Made, Cored and Poured—Chills Were Used Extensively to Get Sound Metal to Meet the Physical Tests

AN UNUSUAL type of casting made at the plant of the Vanadium Metals Co., Groton, Conn., is the periscope support, shown in Fig. 1. A number of these were cast recently in vanadium bronze, for use on several submarines which are now under construction for the Chilean navy. In the production of these castings considerable difficulty was experienced. The job first was laid out to be cast in a horizontal position, with the metal entering the mold through sprues cut in the cope. Since the casting was to be subjected to a severe hydraulic test, it was decided to pour the mold upright through sprues cut in the top, making it unnecessary to resort to the use of chaplets for supporting the cores.

The molds for these castings were rammed in a wood flask, 50 x 100 inches, with cope and drag each 16 inches deep. Both cope and drag were barred and well provided with four pairs of guide pins. The split pattern was first rammed in the drag, after which the cope was made. When the molds were rammed, the pattern was covered to a depth of four or five inches with a fine grade of brass sand, and on top of this a layer of cinders, about 4 inches thick, was rammed to facilitate venting. Heap sand was filled into the flask on top of the cinders and the ramming proceeded in the usual way until the mold was finished. Each mold was well reinforced with gaggers, rods and nails. Six gates, or two for each cylinder, were cut in the end of the mold corresponding to the top of the casting, and each gate was connected to a separate sprue. Before casting, the mold was dried by a charcoal fire.

A total of 34 cores was required for each mold, and with the exception of six, these were placed in the drag. The cores in the cope were tied in place by wires. The large cores, including the three for the cylinders, were made from a flour core mixture and well strengthened with rods. The smaller cores were made of a mixture containing core compound.

After the cores were set, the cope was lowered onto the drag by a traveling crane and the mold was clamped with turnbuckles. The mold then was set on end in a pit, with the top extending slightly above the level of the floor. A circular boiler plate cribbing was next rammed in place around the mold. To provide an outlet for the gases from the mold, boards 1½ or 2 inches thick

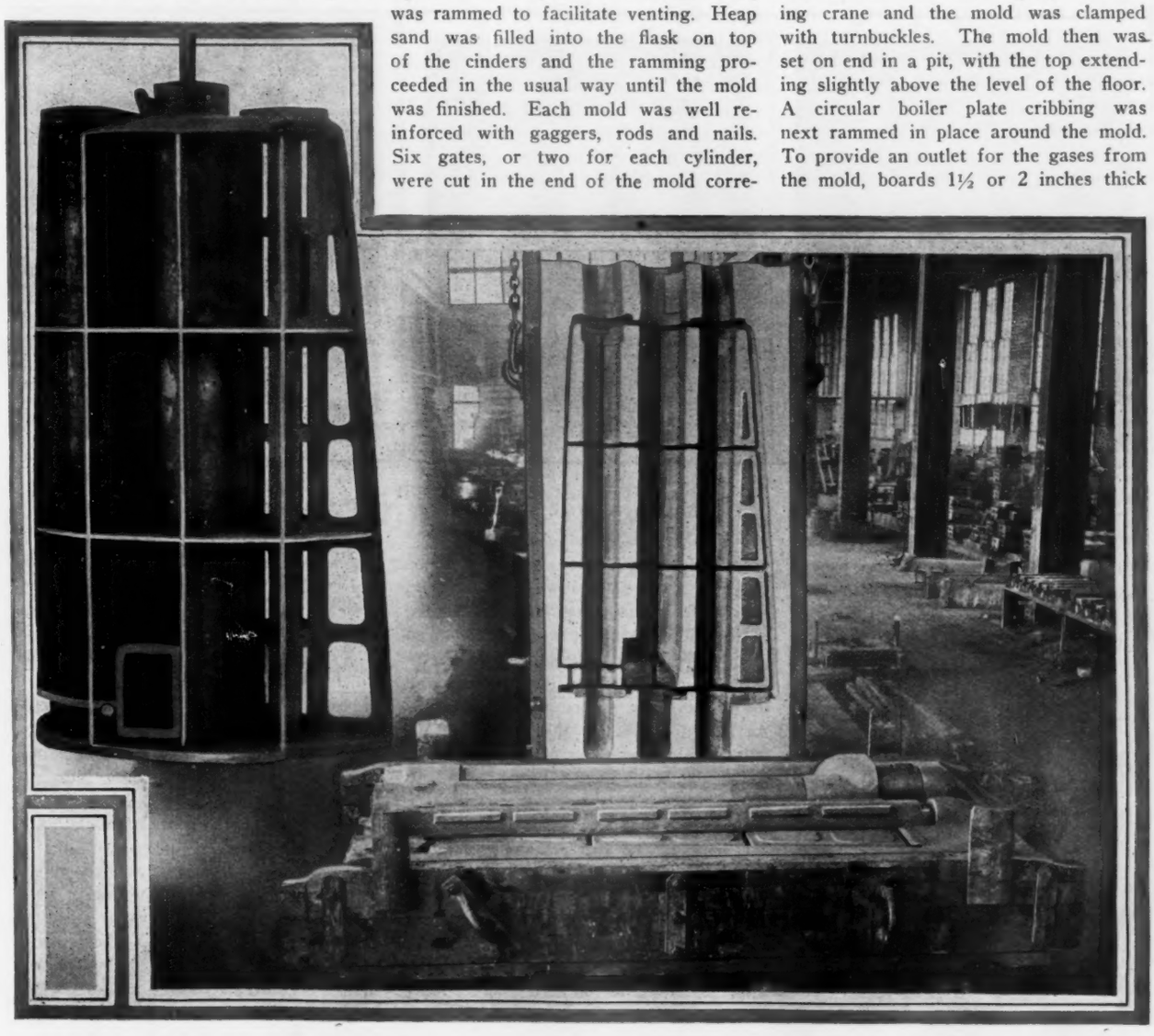


FIG. 1 — AN INTRICATE VANADIUM BRONZE CASTING

FIG. 2—COPE AND DRAG HALVES OF THE MOLD FOR THE PERISCOPE SUPPORT CASTING

and 4 inches wide, were placed vertically alongside the flask at distances of about 2 feet from each other. After the sand had been rammed into the cribbing, these strips were drawn out, thus leaving spaces for the free escape of the gases generated in pouring.

The six sprues next were covered with plugs and a sand basin was rammed on the end of the mold. When the mold was poured, the basin was filled with metal from a crane ladle, after which the plugs were withdrawn and the metal was permitted to enter the six sprues simultaneously. After the metal had been given sufficient time to set, the surplus in the basin was run off into a pig bed. No risers were used.

The weight of each of these castings, when cleaned, was 1,500 pounds, but for pouring 2,500 pounds of metal were required. Great care was exercised to have the metal at the proper pouring temperature, as otherwise the physical properties of the castings would have been impaired. The metal was poured at a temperature sufficiently high to flow freely, but it could not be characterized as hot.

The specifications to which these castings had to be tested provided for a tensile strength of 1,000 pounds per square inch; elastic limit, 18,000 pounds per square inch and 18 per cent elongation. The castings also were subjected to a hydraulic test of 250 pounds per square inch. The walls of the cylinders were 7/16 inch thick and the ribs and webs had the same cross-section. To make the cores required the labor of one man for four days, and two molders were engaged five days on each mold.

How They do it in Mexico

Notwithstanding the recent unpleasantness in Mexico, which resulted in a rapid change in administrations, the casting plants of that country continue operations on the same basis as before the late disturbance. From H. H. Miller, proprietor of the Fundicion De Bronce, Torreon, Mexico, a reader of THE FOUNDRY for many years, has been received a number of interesting photographs of an aluminum casting made from an old, patched automobile part which served as a pattern. Mr. Miller's letter in part is as follows:

"It may be of interest to the readers of THE FOUNDRY to learn how reasonably good castings can be made from an old and broken part. In the United States no effort would have been made to obtain this piece from a jobbing shop as the part would have been purchased from the manufacturer. However, when this job was received we were without railroad communication with the United States and probably it would have taken months to deliver a new casting. Therefore, we decided to try to make it, and the results were exceedingly satisfactory. As shown in Fig. 2, the broken aluminum casting was repaired with three rough patches attached with rivets and stove bolts and two of the ribs were broken. We filled-in the broken ribs and built-up the piece where necessary, by the addition of strips of wood and on the curved sections, strips of leather belting were applied. With this as a pattern, the job was given to a Mexican molder and he was told to see what he could do with it.

"The rivets, nuts and rough edges of the patches tore both the cope and drag when the pattern was drawn. The mold had to be carefully repaired and finished and built-up to the proper height where the patches had been. I think we do a great deal more of this kind of work than the foundries in the United States, and some of the Mexican molders are experts at patching jobs. They have a lot of patience and time is of no particular value to them, especially if some one else is paying for it. The casting weighed 22 pounds."

Fig. 1 is an outside view of the aluminum casting, which shows that the Mexican molder was successful in patching the mold. The interior view of the casting is illustrated in Fig. 3.

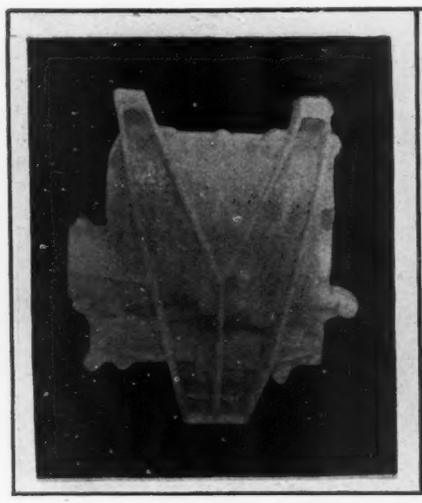


FIG. 1—EXTERIOR VIEW OF ALUMINUM CASTING

FIG. 2 — PATCHED CASTING WHICH SERVED AS THE PATTERN

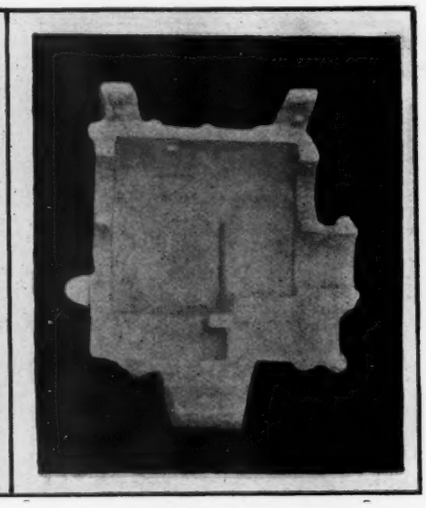


FIG. 3—INTERIOR VIEW OF ALUMINUM CASTING

Linseed Oil Storage

On page 212 of the May issue of THE FOUNDRY, in a description of a core oil storage system, the statement is made that when air comes in contact with core oil it soon becomes rancid and unfit for use. This is entirely incorrect. There are consumed in the United States annually approximately 1,250,000 barrels of linseed oil, of which perhaps 65 per cent is shipped in barrels. The oil frequently stands for several months in these containers, and it could stand for years and would be just as wholesome and pure as when first put into barrels. Linseed oil, if pure, will not become rancid. The commercial value of linseed oil lies in the fact that it does not decompose. Instead of possessing the power of penetration, the reverse is the case, as linseed oil forms a film on the outside of any object to which it is applied. In making cores it forms a film on the outside of each particle of sand, thus binding them together.—W. R. MELVILLE, Spencer Kellogg & Sons, Inc., Buffalo.

The Hydrostatic Pressure on Molds and Cores

Methods of Figuring the Pressure of the Metal on Various Types of Molds and Semi and Fully Submerged Cores

By R R McGowan

TO ENTER fully into the question of pressures exerted by fluids would involve a complete study of that branch of natural philosophy known as hydrostatics, and even with a knowledge of this subject we could not exactly determine by calculation the various hydrostatic forces produced on molds when filled with metal.

Definite results may be obtained with a fluid having a constant temperature such as water, but with a metal which has to be poured into different types of molds, certain factors occur which prevent results from being accurately ascertained; these include the heat of the metal whether dull or hot; the speed at which the metal passes into the mold and whether it passes directly into the mold, or through a pouring basin.

Holding Down Copes

The chief reason why it is necessary that foundrymen should be conversant with the rules relating to pressure, although they may only be approximate, is to enable them to calculate the weight necessary for holding down copes in bedded-in molds.

For bedded-in work various methods are adopted for holding down the cope, but the method to be discussed is that of weighing. To show the necessity for a knowledge of the forces tending to lift copes, let us take as an example a cast iron plate 3 feet square, covered by a cope 7 inches deep. To keep this cope from rising a weight of over a ton would be required.

From the foregoing the danger of merely guessing the weight necessary for preventing copes from rising will at once be apparent. Many foundrymen, however, from experience with this class of work, can determine the weight necessary for a cope, although they may know practically nothing about either calculations or hydrostatics.

Hydrostatics, among other things, treats of the pressure of liquids on the walls of vessels containing them. A metal in its fluid state is a liquid, and a mold when it contains molten metal is a vessel; therefore, the subject is of interest to foundrymen.

Hydrostatics is a subject into many of the details of which it would be impossible to enter within the limits of a single article, yet the points given may be of interest, and should anyone care to develop these by private study such investigations would prove, in the opinion of the writer, highly valuable.

There are certain principles connected with the property of fluids which concern us, and these are as follows:

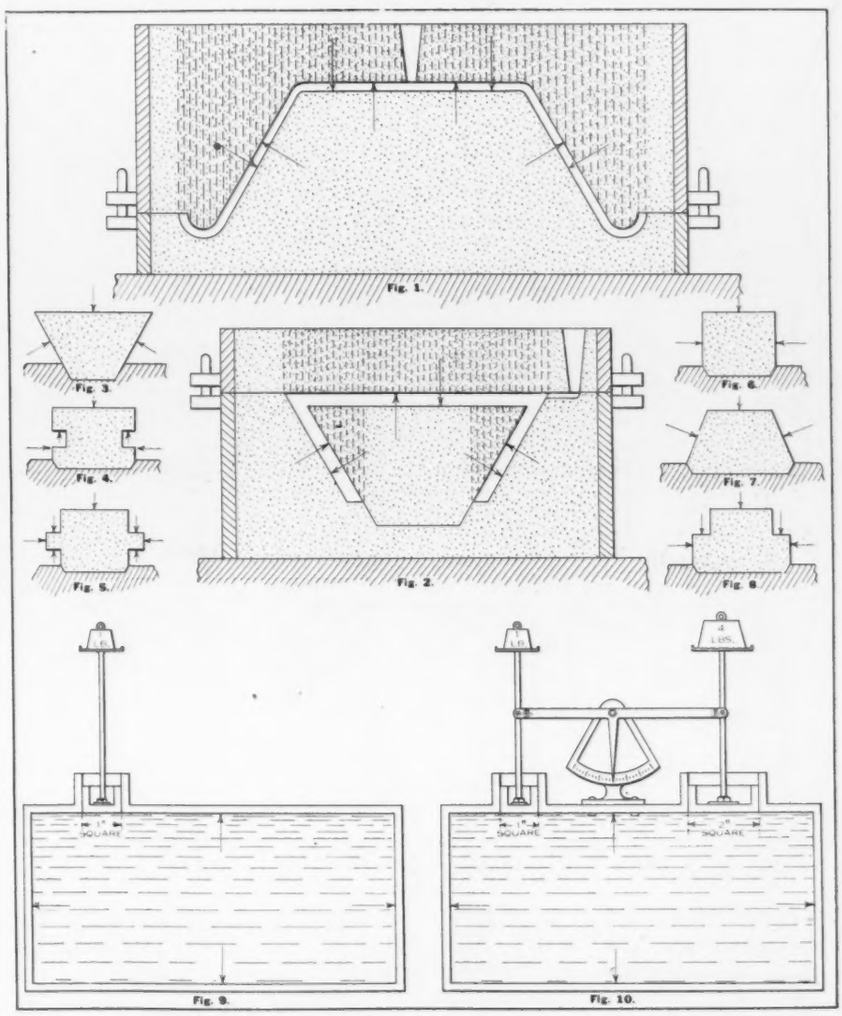
A fluid is a body whose molecules can be displaced by the slightest force, and can readily be divided in any direction

A metal in its molten state complies with this condition, as it readily divides in the directions to which the walls of sand forming the mold determine.

The pressure of a fluid is perpendicular to the surface of the vessel containing it.

This is an important principle, because when a pressure shows an upward tendency, provision has to be made in the mold to counteract this; take for example a mold for a bath tub, shown in Fig. 1.

The arrows in the sketch show the directions of the forces, which will be noted, are perpendicular to the surface of the mold. In this type



EXAMPLES, SHOWING THE HYDROSTATIC PRESSURE OF METAL ON MOLDS

of mold the core requires no fixing, as the forces acting on the core are in a downward direction, but the forces acting on the cope are in an upward direction. Therefore, provision would have to be made to counteract this.

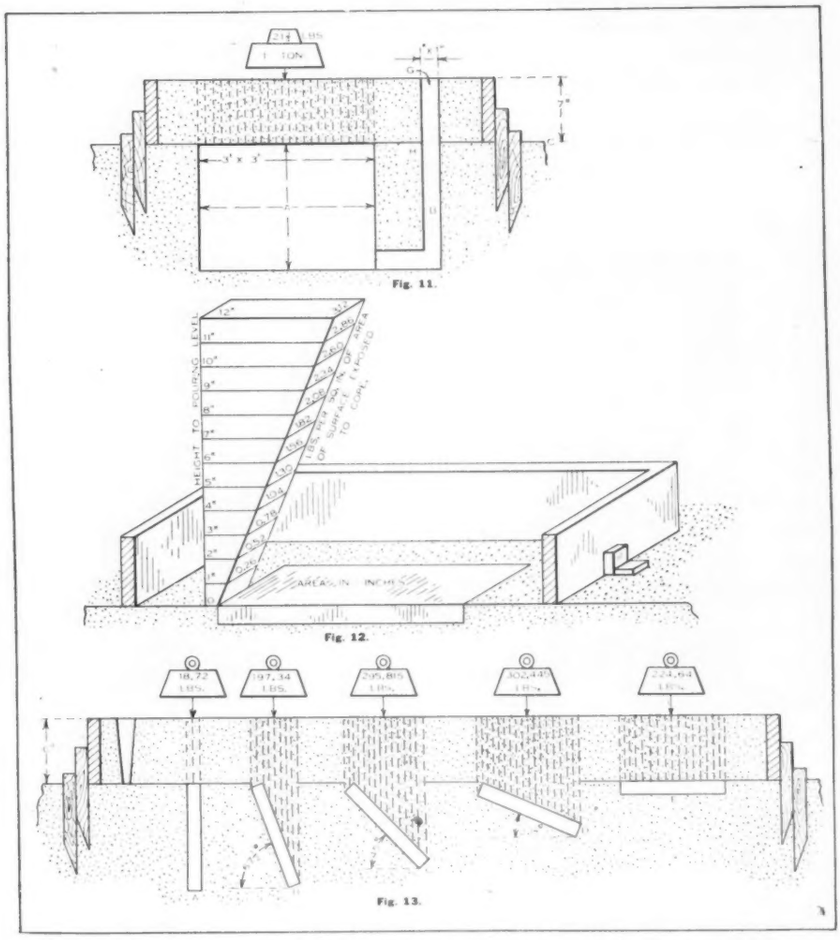
A mold, Fig. 2, next will be considered with its core tapered in a reverse direction to that of the bath tub. In this example the forces acting also are shown by arrows, and the core in this case would have to be held down, either from the bottom by means of a bolt, or more probably by a chaplet on the top.

It is important that the principle to the effect that "the pressure of a fluid is perpendicular to the surface of the vessel containing it", should be borne in mind, as it is this law which determines whether a core or part of a mold tends to rise or not.

From this principle it follows *that any core or part of a mold projecting beyond the vertical line into the mold tends to rise.* Examples of cores having a tendency to rise are shown in Figs. 3, 4 and 5. Examples of cores that do not rise are shown in Figs. 6, 7 and 8.

In a core similar to that shown in Fig. 6, the horizontal pressure or forces acting on the vertical sides are in equilibrium, that is, their intensities are equal and, therefore, nullify the effect of each.

If a foundryman will plot out the surfaces of a mold or cores with arrows indicating the direction of forces as shown in Figs. 3 to 8, the parts requiring holding down can at once be determined.



PRESSURES EXERTED BY FLAT PLATES IN VARIOUS POSITIONS, WITH A DIAGRAM FOR MAKING PRESSURE CALCULATIONS

Let us now consider the cause of this force which tends to raise a cope or a core. To prove this another principle must be cited:

Fluids transmit pressure equally in all directions, that is, when a pressure is exerted on any part of the surface of a liquid that pressure is transmitted undiminished to all parts of the mass, and in all directions.

This is the most important proposition or principle associated with the science of hydrostatics, and it is upon this principle that the rules are based for calculating the weights necessary to counteract the upward thrust on a mold due to *head of metal.*

A common experiment made to prove this law is to take a watertight box, Fig. 9, and insert a tube into the upper cover 1 inch square in area, with a plug or piston fitting exactly into it. If the piston is forced down upon the water with a force equal to 1 pound weight, the water being unable to escape will react upon the piston with the same force, and it will also press on every other square inch of surface area inside the box with the same pressure.

It follows that if there be a surface area inside the box of 100 square inches, and a force of 1 pound exerted on the surface of 1 square inch, the total pressure inside the box will be 100 pounds.

This can be proved by having a box with two pistons, Fig. 10, one with an area of 1 square inch and the other with an area of 4 square inches, the latter having an area of four times the former. If a weight of 1 pound be placed on the smaller piston a weight of 4 pounds would have to be placed on the larger piston to balance the pistons.

Application of Principle

Let us apply this principle to a mold; the smaller piston referred to is the pouring gate, and the piston with the larger area is the cope or top part of the mold; for every pound pressure per square inch of area in the gate, you have the same number of pounds pressure per square inch of surface inside the mold. If this pressure is on every part of the mold, it must also be exerting itself on the cope, and as the cope is the only part likely to yield, weights must be placed on the cope according to the surface area of the molten metal in direct contact with it.

In addition to the pressures we have mentioned, there is an additional pressure on the sides which increases with the depth of the mold, and also on the bottom due to the weight of metal, but we will not consider this as it is principally the pressure on the cope with which we are at present concerned.

In Fig. 11, *A* is a vessel or mold with a cross-sectional area of 1,296 square inches, or 3 feet square; it will be assumed that it is connected to *B*, another vessel which is the gate, with a cross-sectional area of 1 square inch.

If we pour molten metal, cast iron for example, into the vessels, *B*, from *G*, a point 7 inches from the top of the vessel, *A*, until the metal rises to *CC* the top of the vessel, *A*, there

will be no pressure in the mold except from the weight of the metal.

We will assume that the top of the vessel, *A*, has a cover, that is, a top part or cope, which prevents the metal from rising above the level *CC*, and we add a cast iron weight of molten metal 1 inch square by 7 inches high, which would weigh 1.82 pounds, on the top of the vessel, *B*.

If it is true that fluids transmit pressures equally in all directions when a pressure is exerted on any part of its surface, it follows that on every square inch of area inside the mold, *A*, there will be a pressure of 1.82 pounds. Therefore, the pressure exerted on the underside of the cope will be $36 \times 36 \times 1.82 = 2{,}358.72$ pounds.

Weight Diagram

To assist in determining the weights necessary for copes the diagram shown in Fig. 12 may be found useful. To apply the diagram the following example will be solved:

Find the weight, due to head of metal only, required to hold down a cope covering a flat plate 36 inches long and 36 inches wide. The height from the surface of the plate to the level of the pouring basin is 7 inches.

This example is solved as follows: Take the number representing pounds per square inch opposite 7 in the diagram; this is 1.82; multiply this number by the number of square inches on the surface of the mold exposed to the cope. The result is the number of pounds required to hold down the cope due to head of metal. In this example, $1.82 \times 1{,}296 = 2{,}358.72$ pounds.

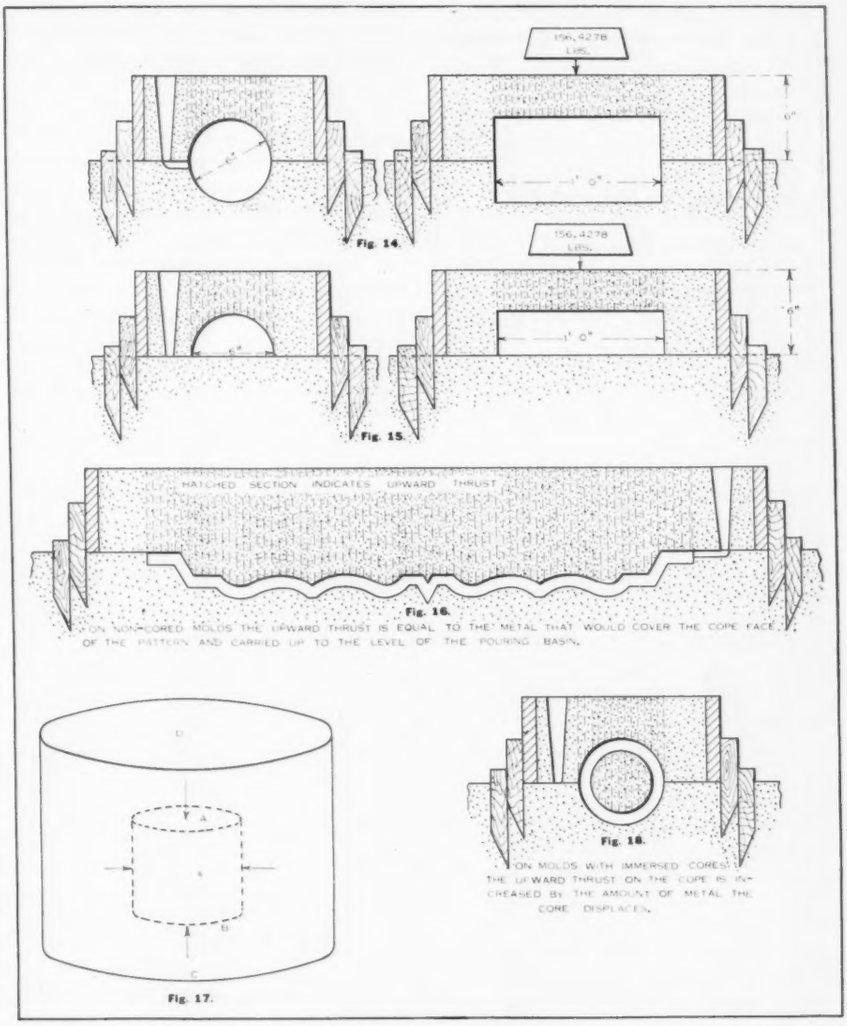
Fig. 13 shows a cast iron plate, 12 x 12 x 1 inches, molded in five different positions, *A*, *B*, *C*, *D* and *E*, covered by a cope 6 inches deep. Plate *A* is molded in a vertical position; plate *B* is molded at an angle of 67½ degrees to a horizontal line; plate *C* is molded at an angle of 45 degrees to a horizontal line; plate *D* is molded at an angle of 22½ degrees to a horizontal line, and plate *E* is molded in a horizontal position.

The upward thrust exerted by *A* on the cope is 18.72 pounds; by *B*, 197.34 pounds; by *C*, 295.815 pounds; by *D*, 302.445 pounds, and by *E*, 224.64 pounds.

Therefore, the weight required on this cope due to head of metal would be 1,038.96 pounds.

It does not always occur that we are asked to deal with castings having a flat surface. However, if the laws dealing with flat surfaces be understood, the same principle may be applied to other castings no matter what their form may be.

Take a cylindrical casting for example, two views of which are shown in Fig. 14. Let the casting be 12 inches long and 6 inches in diameter, parted at the center and covered by a cope, 6 inches deep. The upward thrust exerted on this cope would be 156.4278 pounds, equal to a block of cast iron 6 x 6 x 12 inches less half the weight of the casting, as shown hatched in the sketch, Fig. 14. In the example illustrated in Fig. 14, the force exerted on the cope is exactly the same as if the casting had been half


156.4278 Lbs.
Fig. 14.
156.4278 Lbs.
Fig. 15.
HATCHED SECTION INDICATES UPWARD THRUST
Fig. 16.
ON NON-CORED MOLDS THE UPWARD THRUST IS EQUAL TO THE METAL THAT WOULD COVER THE COPE FACE OF THE PATTERN AND CARRIED UP TO THE LEVEL OF THE POURING BASIN.
Fig. 17.
Fig. 18.
ON MOLDS WITH IMMERSED CORES THE UPWARD THRUST ON THE COPE IS INCREASED BY THE AMOUNT OF METAL THE CORE DISPLACES.

PRESSURES EXERTED BY CYLINDRICAL SURFACES AND CORES IMMERSED IN METAL

cylindrical in form as shown in Fig. 15.

From the foregoing observations it will be noted that in non-cored molds the upward thrust acting on the cope is equal to the amount of metal that would lie on the exposed surface of the pattern facing the cope and carried up to the level of the pouring basin.

An example showing this principle applied to a casting of an irregular shape is shown in Fig. 16.

We have already referred to certain cores which would rise, and others that would not rise, when surrounded by metal. Let us now refer to the pressure on cores immersed in molten metal. When a core is wholly immersed in molten metal its entire surface is subjected to pressure in every direction, perpendicularly to its surface and increasing with its depth. Let us take as an example a cylindrical core placed vertically into a mass of molten cast iron, Fig. 17. Owing to the form of the core the pressures acting are horizontal and vertical. The horizontal pressures around the core are in equilibrium, that is, their intensities are equal, contrary to each other, and, therefore, neutralize the effect of each and the horizontal pressures can be ignored.

Vertical Pressures

The case is different with the vertical pressures, which are unequal and tend to raise the core. Let us assume the core is 1 inch long, and the area of each end is equal to 1 square inch. The top surface of the core, *A*,

is immersed 2 inches from the top of the mold, *D*.

It is evident that the downward pressure on *A* is equal to a column of cast iron having the side, *A*, for its base and *AD* for its height, the weight of which would be 0.52 pound. Also that the upward pressure on *B* is equal to a column of cast iron having the side, *B*, for its base and *BD* for its height, the weight of which would be 0.78 pound. Therefore, the difference between the force acting downwards, 0.56 pound, and the force acting upwards, 0.78 pound, is the actual force acting on the core, which is 0.26 pound in an upward direction, the weight of metal the core displaces.

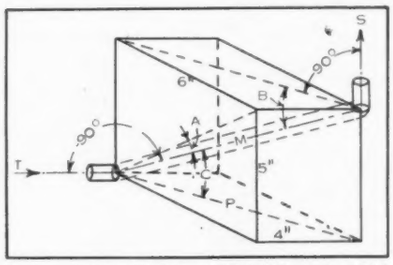


FIG. 1—SUGGESTED METHOD OF COMPUTING ANGLE OF FLANGE

It makes no difference what position this core takes up in the molten metal so long as there is a layer of molten metal underneath the core, the force tending to raise it being exactly the weight of metal it displaces.

When the surface of the core, *B*, comes into contact with the lower part of the mold, *C*, there is no upward thrust, the forces are then horizontal and downward as shown in Fig. 6. The case is different when the surface of the core, *A*, comes into contact with the top of the mold, *D*. The metal is now underneath the core and endeavors to find its own level. Therefore, the force acting upwards on the core is the same as when *A* was 2 inches from *D*, namely 0.26 pound or the weight of metal the core displaces. The same laws apply if a core is placed horizontally in a mold, Fig. 18.

If we place a core in the cylindrical casting shown in Fig. 14, the upward force exerted on the cope would be increased by the weight of the metal which the core would displace.

We will repeat the statement made in an earlier part of this paper that it is impossible to determine exactly the various hydrostatic forces in working with a molten metal owing to the varying temperatures, different speeds and methods by which molds are cast.

Every molder who takes an intelligent interest in his work should be conversant with the pressures acting on his mold, and he should be able, when occasions arise, to calculate the extent of these forces, even though the results may only be approximate. In the foregoing illustration the hatched sections indicate upward thrust.

Angles for Pump Connection to Radiator

By H. W. Hawkins

On page 30 of the January, 1913, issue of THE FOUNDRY, was published an article entitled "Setting the Angles for the Pump Connection to an Auto Radiator". The author appears to have made a hopeless attempt to solve a very simple problem.

I have reproduced Fig. 2 of the original article, which will be referred to as Fig. 1, rearranging the data correctly, and I assume that *I* and *S* are, respectively, the radiator and pump connections. The author of this article, by his formula, states that the distance across corners of a block of wood on the same horizontal plane is greater than the distance across the diagonal corners, in the same vertical plane as above, which is absurd. Therefore, if $P = \sqrt{6^2 + 4^2} = 7.21$, $M = \sqrt{P^2 + 5^2} = \sqrt{7.21^2 + 5^2} = 8.77$. Again, of what use to a patternmaker or anyone else are such angles as *A*, *B* and *C*? The tangent of angle *B* or $C = 5/P$, but $6/M$ is certainly not the tangent of angle *A*, and neither does the ratio bear any relation to angle *A*, but if angle *A* should be required, its line can be found from the data given, *i. e.*, line $A = 4/M$.

Before proceeding with the method I adopt in solving such problems, and referring to Fig. 1 of the original article, and assuming that the position of the radiator connection is fixed, it is obvious that if the connecting pipe, between radiator and pump be swung round in a circle, with its center concentric with the radiator connection, it would trace out in its path a cone, the apex of which would be concentric with the radiator connection and the connecting pipe would represent the slant height of the cone, as shown in Fig. 2. Using the same symbol as in Fig. 1, for clearness, I will now calculate the necessary data. The radius, *R*, of the base of said cone, which equals $\sqrt{4^2 + 5^2} = 6.4$ inches, and the height of the cone is equal to the effect, 6 inches. Now swing the connecting pipe, *M*, about center, *T*, until it assumes a vertical position, as shown dotted in the end view, Fig. 2, and project it from this position onto the elevation (also shown dotted), when it will be seen that the flange, *T*, must be fixed at an angle, *X*, with pipe, *M*, this angle holding good for any position of the pipe, *M*, on the periphery of the cone. This can be easily seen by referring to Fig. 2; also that flange, *S*, must be fixed at an angle, *L*, with pipe, *M*, as shown in the end view, Fig. 2. The tangent of angle, $X, = \frac{R}{6} = \frac{6.4}{6} = 1.06 =$ tangent of 45 degrees 50 minutes, and the tangent of angle, $L, = \frac{4}{5} = 0.8 =$ tangent of 38 degrees 40 minutes. The length of connecting pipe, *M*, $= \sqrt{6.4^2 + 6^2} = 8.77$ inches. The above data is all that is necessary, whether for the patternmaker or for the making of template, etc.

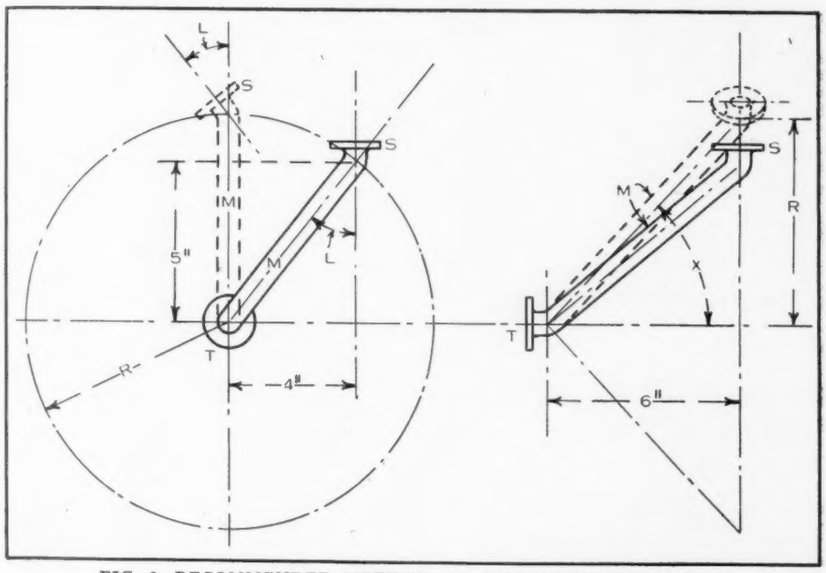


FIG. 2—RECOMMENDED METHOD OF COMPUTING THE ANGLE

As is usual, the radiator and pump connections have fixed relations and if the connecting pipe with flange is made as shown, it cannot help but make a perfect connection.

How I Reduced Costs With Molding Machines

This Article Was Awarded First Prize in the Contest Conducted by THE FOUNDRY on Economies Effected by Molding Machine Operations

Ey A M Jones

IF a constancy of ideal conditions could be maintained in the molding and casting of any given piece of work which is to be produced in the foundry, perfect castings would prevail. But absolutely ideal conditions cannot be attained in either the molding or the pouring of a casting. However, modern foundry engineering has, in the past few years, made rapid strides towards perfection in the founding art. Furnace operation has so greatly improved that it is now possible to bring forth mixtures exact, within reasonable limits, and at temperatures desired.

For sustaining constant conditions in the production of castings the greatest factor has been the molding machine, as this offers a rapid and, therefore, efficient means of making castings; being a machine, it operates without the variations which result when the molding is done by hand.

The purpose of this article is not, however, to dwell upon the theory of the molding machine, which might, nevertheless, be gone into quite extensively, but to show by statements of facts and figures what economic value a given machine may have when properly equipped and operating on a class of work which is so selected that every salient point of efficiency in the machine may be utilized to the utmost advantage.

At the plant of the Federal Malleable Co., West Allis, Wis., three Berkshire, pattern-lifting, heavy duty squeezers, Figs. 2 and 3, are in operation and by being properly equipped with work suitable to them show molding cost reductions of considerable proportions.

Before going into figures showing economies effected in molding, an explanation of the simple operation of this machine is perhaps fitting. The greatest efficiency of this squeezer, of course, lies in its pattern-lifting device. When match-plates for producing castings not requiring cores are used, as shown in Figs. 2 and 3, they are so made as to extend ½ inch beyond each end of the flask, while on the cope of the flask are put four ears, each extending about 1 inch from the flask at right angles.

Fig. 2 shows a complete mold with cope and plate lifted by means of the lifting pins which are raised by throwing over the handle at the lower part of the machine. The top of the lifting pins strike the ears on the cope, thereby raising it for a certain distance when lugs, which are fastened on the lifting

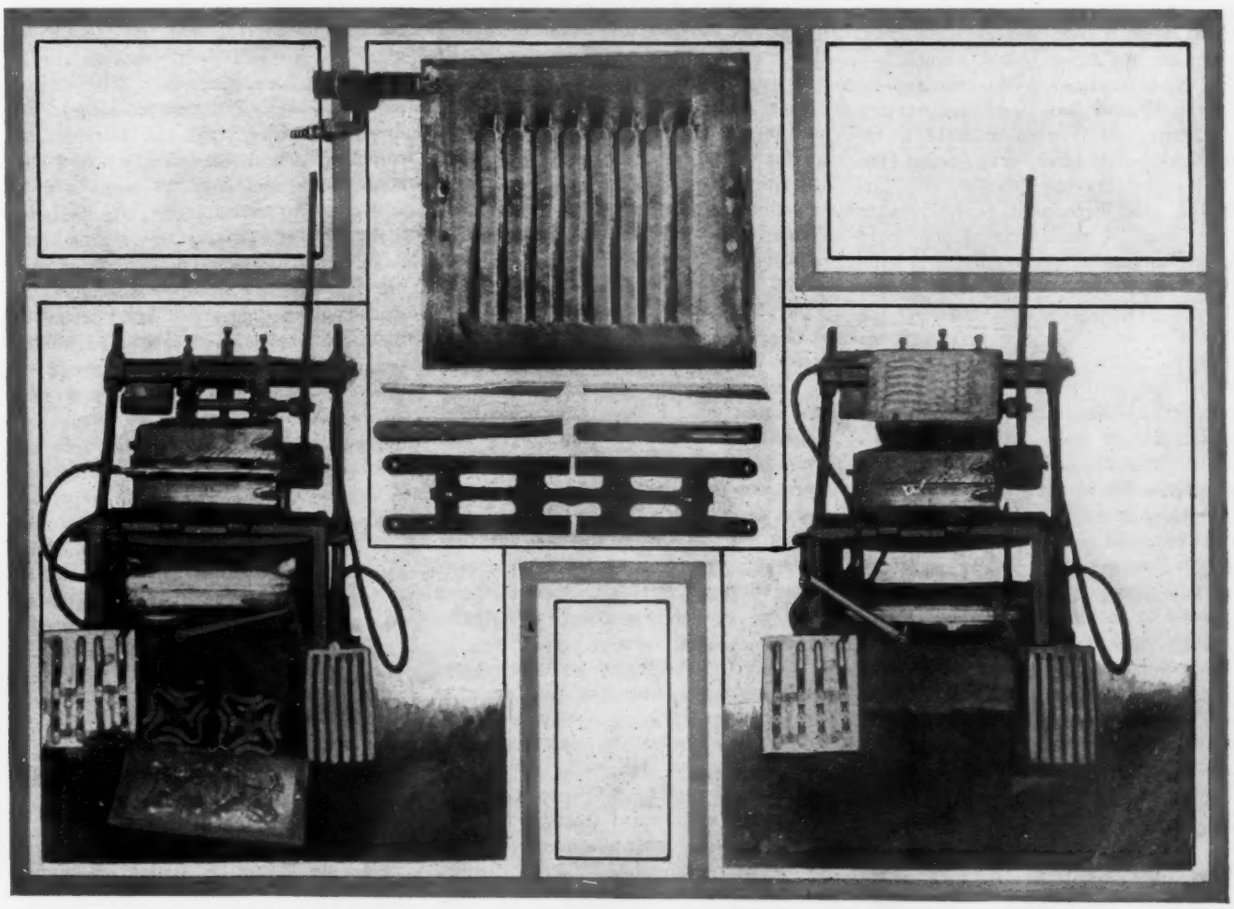


FIG. 1—THE MATCH-PLATE, FOUR VIEWS OF THE CASTING AND THE GATE

FIG. 2—SQUEEZER WITH COPE AND MATCH-PLATE LIFTED

FIG. 3—THE MOLD CLOSED READY TO LIFT OFF

pins at the proper point, raise the match-plate from the drag, leaving it clear of both cope and drag. A ⅝-inch vibrator operated by a knee valve at the lower left part of the machine, vibrates the match-plate during the lift.

All that is now necessary is to pull the match-plate forward from between the cope and drag, which is done rapidly, and in no way disturbs either. The lever or handle next is thrown back to the left, which operation lowers the lifting pins and allows the cope to settle on the drag and the mold is completed, as shown in Fig. 3. The snap flask is removed and the finished mold is placed on the floor. During the molding the flask is held in exact position by an adjustable angle iron placed to serve as a guide at the left rear corner of the flask. All other operations are performed as on the ordinary hand squeezer. This type of machine differs slightly from the simple squeezer, having a toggle squeezer head which greatly increases the pressure exerted.

The Match-Plate

Fig. 1 shows a match-plate of eight patterns, which is operated on one of the machines described. Before the installation of these machines a simple squeezer was used, working a gate of four pieces in an 8 x 24-inch flask with a 3¼-inch cope and 2¾-inch drag, giving an unrammed sand volume of 1,152 cubic inches. The match-plate shown in Fig. 1 has twice the number of patterns and is used in a 14 x 14-inch flask, cope and drag being the same as the previous flask. The unsqueezed sand here used is 1,176 cubic inches, only 24 cubic inches per mold increase, about 2 per cent, over the previous mold, with an increase of 100 per cent per mold in castings. Four different views of the casting are shown in Fig. 1.

When the gate in a match was used in the 8 x 24-inch flask, the molder was paid 2 cents per mold. With the match-plate of twice the number of pieces, and the increase of 24 cubic inches of sand per mold, a common laborer is paid 1.7 cents per mold. The mold, with this plate, is made with one squeeze as against the two with matched patterns. One mold is now equal to two as formerly made, with a direct labor saving of 0.6 cent on each mold made, without taking into account the economy effected by producing a larger number of castings with the resultant increase in the tonnage.

The average production per day, figured over a considerable period of time, from the gate of patterns was 577 pounds, while from the match-plate the average production per day figured for the same molding time is 793 pounds per day. This is an increase of 216 pounds per day, or 37 per cent increase per day on a tonnage basis.

Figuring the molding costs from the piece rate figures given, the molding cost of the castings made from the gate of patterns was $10.17 per ton, while castings are now made from the match-plate at a molding cost of $5.87 per ton, a reduction of 42 per cent on the molding cost.

Economies Effected

The average number of good molds per day made from the gate was 143, while the average number of good molds per day made from the plate is now 129. The only discouraging feature of the process now is the fact that the laborers put on the machines produce a somewhat higher proportion of scrap than a molder working the gate, but the increase in the production and the cutting of the molding cost are of such proportions as to make this feature a secondary consideration.

On this particular work the installation of the type of machine, shown in Figs. 2 and 3, has effected a direct saving of 42 per cent on molding cost and has given an increase in production of 37 per cent over the old method. The machines have not been operating long and from an inspection of daily figures, it can be shown that the cost is gradually falling lower and the production climbing in the same proportion as the cost decreases.

Figs. 2 and 3 show one of these machines equipped with a match-plate on similar work. At the lower left hand are shown two gates which were formerly run together in a 13 x 16-inch flask, 4-inch cope and 3-inch drag, with a sand volume unsqueezed of 1,456 cubic inches. An 11 x 17-inch flask, same cope and drag, is now used. The sand volume here is 1,309 cubic inches, a decrease of 147 cubic inches, while instead of having four pieces to the mold, six are now run. Formerly a price of 2 cents per mold was paid. This has been reduced to the standard of 1.7 cents per mold as on the work previously described. The increase of production on this work is 10.2 per cent, while the molding cost was reduced from $8.35 to $6.44 per ton, a saving of about 23 per cent on direct molding labor.

The two plates just described will run three or four months of the year, as they are quantity jobs, so it is plain that the machines soon pay for themselves on these castings alone.

Below the center of the machine, Fig. 2, is shown a third match-plate for making the simple bracket castings shown above the plate. These castings are light and show a decrease in molding cost when machine-made of only 73 cents per ton which, considering the weight of the castings, 6 ounces, amounts to more than it sounds.

It will be observed that work is selected which requires no cores. If cores are to be set, the cope has to be lifted off and set aside as usual. While these machines are also adopted to core and deep draught work, their greatest efficiency is obtained when the cope is not removed from the lifting pins.

The machines, by means of their toggle squeeze, exert a uniform pressure on the mold, and as the molder strikes-off the sand from the flask before squeezing, each mold is virtually alike in point of density.

Every malleable foundry has simple, no-core, long-running jobs which, when mounted on a suitable machine, will eliminate unnecessary movements and can be made to show extensive economies and will eliminate skilled labor.

Etching Glass

Question:—How can we use ammonium-fluoride for etching glass? We are informed that this chemical is sometimes used for etching by applying with a quill pen. We have obtained no action whatever and are rather skeptical as to its power to attack glass.

Answer:—Hydro-fluoric acid is the only chemical used for etching glass. Ammonium-fluoride has no action on glass. This fact will be apparent to you when you note that the quantity purchased was in a glass container. The fluoride together with the concentrated sulphuric acid produces a hydro-fluoric acid action and may be used with a quill pen for writing on glass surfaces.

Equally as satisfactory results may be obtained by using fluorspar and sulphuric acid. Certain compounds of silicon in the glass are acted upon by the acid and the surface is rendered opaque. The glass may be covered by some resistant, such as wax and may be relieved and etched by means of the gas. In the use of this material, the operator should avoid breathing the fumes, as they are strongly poisonous, and in contact with the skin, the acid produces blisters and slow-healing sores. By using an aqueous solution of hydro-fluoric acid for etching glass, the attacked portions are transparent.

A two-ply britannia metal, composed of a facing of britannia with a core of a much cheaper base metal, is being manufactured by the Hoyt Metal Co., St. Louis.

Herman Gehnrich, Brooklyn, manufacturer of core, japaning and enameling ovens, is now located in his new plant.

How I Estimate the Selling Price of Castings

This is the Prize-Winning Article on This Subject Submitted in the Contest Conducted by THE FOUNDRY, Which Closed May 1

By R O Shive

IN WELL-REGULATED foundries the selling price of castings is determined by reliable cost and labor figures, which make the term *estimating* a poor substitute for arriving at the selling price of their particular commodity.

Every foundry, however small, is important enough to maintain a cost system, but the system must be up-to-the-minute and painfully truthful, be it only the owner's private handbook. Specialty shops producing a uniform tonnage should proportion overhead charges including stores, sales and superintendency, etc., to tonnage, whereas jobbing shops must distribute this cost among the direct labor, in order that the light section casting assumes its proper burden as against the less difficult heavy casting. Each foundry, of course, must determine the limits of weights for light and heavy castings.

Special Equipment

Too little attention is paid to the item of special equipment as regards cost distribution. In nine cases out of ten this special equipment is good only for that job for which it was constructed; the cost of reconstruction for another special job is about the same as for new equipment, less perhaps a small amount of material. It should be further borne in mind that orders requiring special equipment should bear this burden, as the chances for duplicate orders are too great to assume any risks.

As pig iron is not obtainable in all localities at the same price, there is no fixed rule for dealing with this item. The pig metal stock, however, should be considered a material for current consumption only and, therefore, it is necessary to figure the metal at the prevailing market price, plus the cost of delivery from the furnace. The yard expense includes the items of storage, handling and miscellaneous yard labor, and should be added to the cost of the metals at a fixed price per ton. In other words, the metal costs a certain amount per ton delivered to the foundry yard, plus the delivered cost of fluxes and cupola additions, plus the cost of handling and transporting the material from the yard to the cupola charging floor.

Don't deceive yourself by juggling your overhead charges and the margin of profit should vary with the class of metals handled. It is well-known that gray iron can be produced with the lowest percentage of average loss, malleable follows, with cast steel a poor third. As has been demonstrated by capable foundrymen, gray iron castings can be produced with an average loss of 3 per cent, it being assumed that shop conditions are satisfactory to insure high grade work. Losses in malleable foundries average from 5 to 8 per cent and a steel foundry man who can hold his average loss below 10 per cent is considered an expert. Steel foundry losses frequently will run as high as 25 per cent under good working conditions. It, therefore, follows that the foundryman who assumes the greatest risks should have the largest profits, and if he can anticipate his average cost or loss it further proves his superior management. It is my contention that castings that are hazardous and difficult to produce, should be figured with a larger margin of profit than specialty work, although the net profits will be about the same in either case.

The foregoing outlines briefly how accurate cost data are obtained, and having these figures before us we are ready to determine the selling price of our castings.

It is essential to know how much floor space the order will require, what delivery is demanded, and the tonnage of metals to be poured. The inquiry may be accompanied by a pattern number, the pattern being in our storage, and in this case the work is familiar to us as to weight or size. If the pattern has not been submitted previously, a sketch or blue print accompanies the inquiry from which we figure our pattern cost, including labor and materials, and also the weight of the casting. From the blue print we also determine the number and cost of cores and the number of castings one man or crew, or molding machine will make per day. The weight of the casting, the number and cost of the cores and the materials for the pattern can be determined accurately, while the labor cost is obtained from the shop cards. If any extras are included in the inquiry, these are next estimated.

It presently occurs that castings are to be made to certain specifications, or they are to be machined, or they will be inspected by the customer's representative. No extra charge is made if the specifications are standard, but if special properties are demanded, an extra charge should be made, 15 per cent being considered a fair addition. If the castings are to be machined, it entails extra labor for inspection and additional molding costs, depending upon the design of the casting. This extra labor amounts to not more than 1 per cent for light work and is less for heavy castings. Castings for railroad work must conform to certain specifications and, in addition, they are rigidly inspected. It is not within the province of this article to discuss the merits of the different railroad specifications, but if a foundryman accepts this class of work, an intimate acquaintance with the exacting requirements will save him heavy losses. The extra cost entailed

SUMMARY OF ESTIMATE
JOHN SMITH CAST STEEL FOUNDRY CO., ST. LOUIS.
Inquiry No. 100 for 100 locomotive wheel centers, Atlantic & Pacific Railroad.

	Estimated cost.
Patterns and core boxes complete	$225.00
Molding cost per wheel at $4	400.00
Cores cost per wheel at $1.50	150.00
Cleaning, chipping and sand-blast per wheel, $5.25	525.00
Shop inspection per wheel, $0.35	35.00
	$1,335.00
General expense, 30 per cent	400.50
	$1,735.50
Basic steel, 800 pounds each, 80,000 pounds at 3 cents	2,400.00
	$4,135.50
Profit, 10 per cent	413.55
Total estimate	$4,549.05

in meeting specified requirements should be distributed over the tonnage of castings to be produced.

After the direct and indirect costs have been figured they are summarized, as shown in the accompanying table, the general expense and profit being added as indicated.

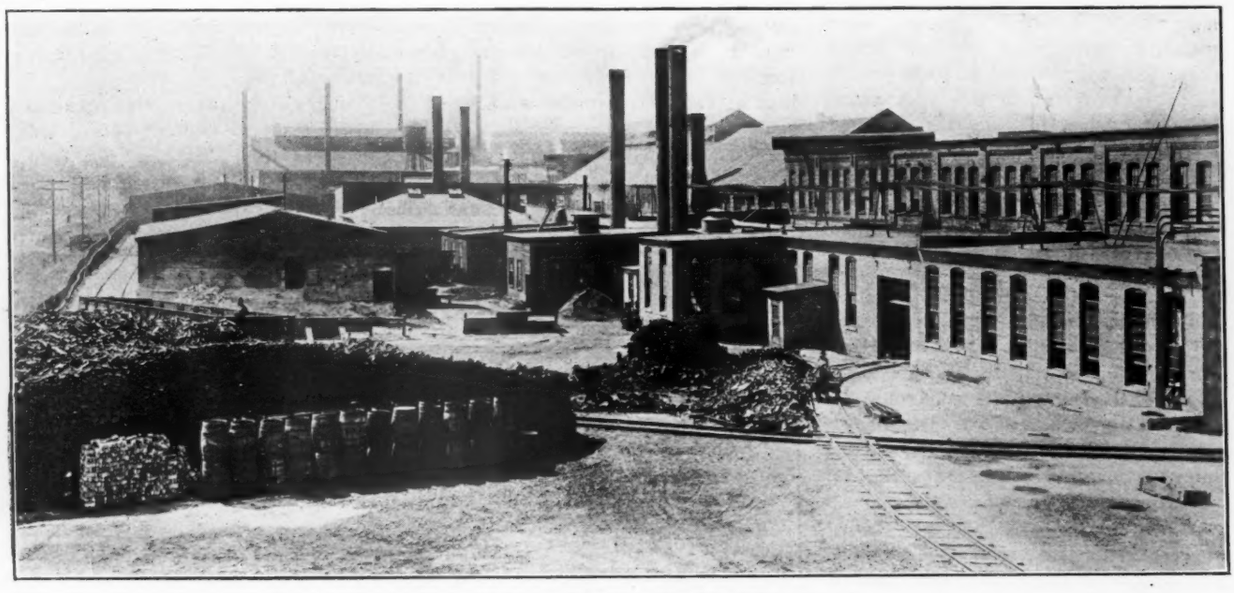
From the summary it will be noted that no general expense is added to the item of basic steel or pig iron for the reason that all general expense has been absorbed as previously outlined. This is a noteworthy feature, as the melted metals, the bulk of the cost, is an entirely separate item, and has no chance of carrying burdens for other departments. The costs as outlined for pig iron are perhaps the easiest to obtain and are always classified separately.

It will be noted that the cost of the wheels has been based on our inspection and no reference is made to wheels cast to certain specifications other than provided for by general foundry practice. If railroad inspection and specifiacations have to be met, 15 per cent should be added to $4,135.50 and the profit figured to determine the selling price per 100 wheels. The summary outlined is not accurate as to prices or quantities, the figures being given merely to extend the items to determine a total. The summary, however, is correct in form, and if carefully followed is all that is required to complete the estimate of the selling price.

While the estimate given herewith is presented merely as a reliable and accurate method of determining the selling price of cast steel wheel centers, the system is applicable to any casting of any metal, and is adaptable to inquiries of one or any number of castings. It will meet the requirements of both specialty and jobbing foundries, if the contract is secured, it forms the basis of the schedule for the various departments in their proper execution of the order.

A Well-Kept Yard

Foundry yards proverbially are disorderly. Gradually, however, the more progressive concerns are beginning to appreciate that dividends are returned by neatness and cleanliness about the plant. The accompanying illustration shows a model foundry yard at the plant of the Edgar Allen American Manganese Steel Co., Chicago Heights, Ill. The yard is covered with a layer of cinders which keeps it at all times in a dry and sanitary condition and rubbish of all sort is removed daily. The main supply of scrap shown at the left of the illustration is piled neatly and carefully, thus saving space and time in unloading the cars. The barrels are arranged in a row and even the bricks are piled carefully instead of being dumped in an indiscriminate heap. A yard of this kind is not only an economy, but is a source of pride to the owner.



AN ORDERLY FOUNDRY YARD

The International Molding Machine Company

The International Molding Machine Co. is moving its offices and works from 2300 South Western avenue to 2614 West Sixteenth street, Chicago. The change of location has been made necessary by increased business, demanding improved facilities.

A New Canadian Railroad Foundry

The Grand Trunk Pacific railway, at its new shops at Transcona, 6 miles east of Winnipeg, Man., has erected a new foundry which is modernly equipped throughout. In connection with it, locomotive, carpenter and pattern shops have been built, the latter two being housed in one building, a two-story, steel-frame structure, 100 x 70 feet, adjacent to the foundry. The upper floor of this building is used for pattern storage and an attempt has been made to make the building absolutely fireproof. The front of the lower floor is devoted to the carpenters and the rear half to the patternmakers. This floor is connected with the foundry by an industrial track. The shop is equipped with toilet and locker rooms containing porcelain basins and steel lockers with expanded metal doors. Two line shafts, each belted to a 25-horsepower motor, run the full width of the shop, driving the machines in each department. The lower floor is constructed of 3-inch planks fastened to 4 x 6-inch timbers bedded in concrete. The building is heated by the indirect system of radiation.

Storing the Patterns

The upper floor of the shop is made of concrete, supported on square concrete pillars. The patterns are stored on metal shelves and racks about 12 feet high. The upper shelves are reached by steps leading

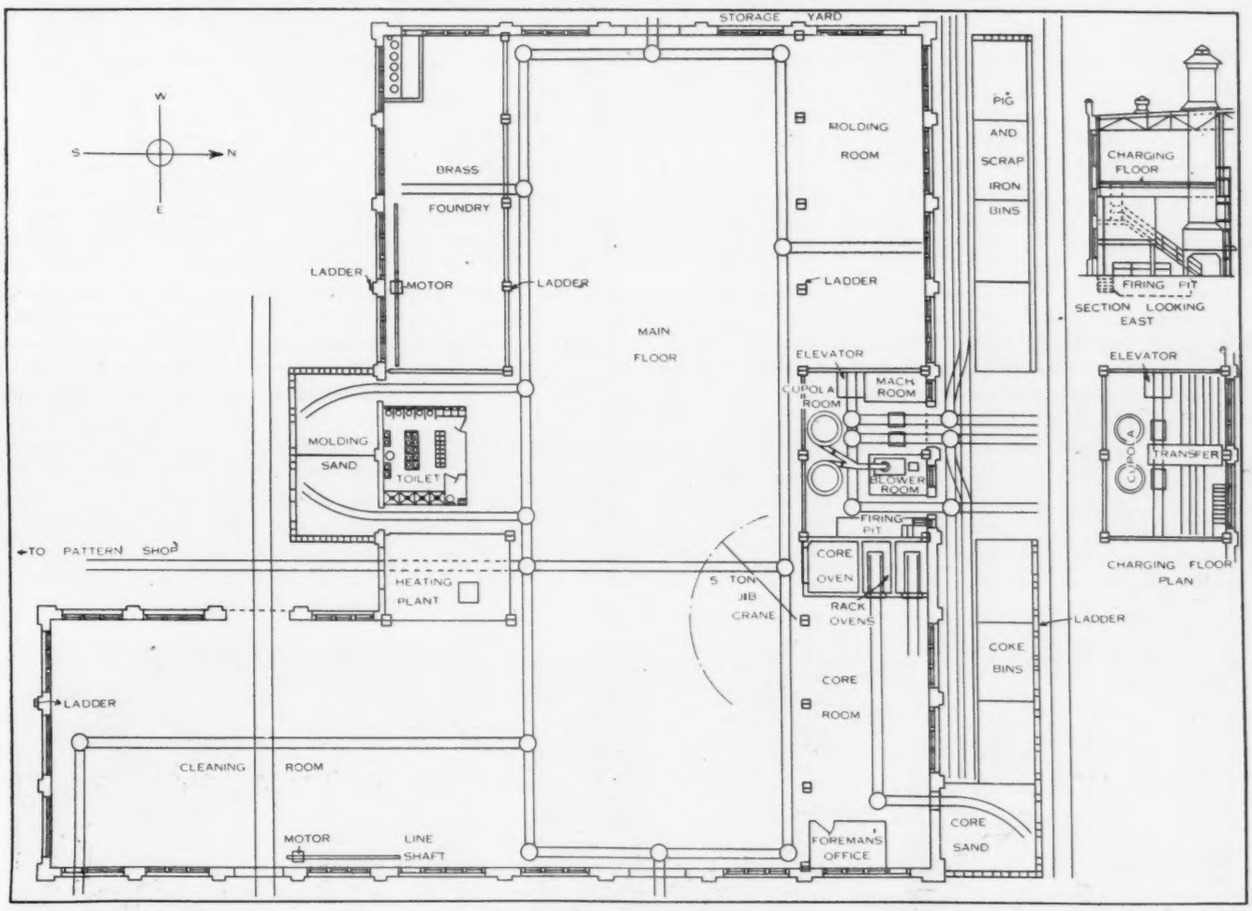
to the steel gratings that extend along the front of the shelves, about 6 feet above the floor. Larger patterns, such as cylinders, smokestacks, etc., are stored on the floor at the rear of the room. Illumination is provided by electric drop lights. This room is connected with the lower floor by an enclosed stairway fitted with firedoors, large patterns being taken up by an hydraulic elevator that runs in an enclosed concrete shaft, provided with firedoors.

The gray iron foundry is 200 x further served by light bracket cranes attached to the columns. A 5-ton electric jib crane is attached to the column nearest the core oven, to handle the larger cores between the oven and the molds.

Cupola Room and Core Ovens

The cupola room and core ovens divide the north bay into two parts and are situated so as to serve the whole foundry. Small work is molded in the west half and the east half is used for the core room. An industrial railway extends through the center of the core room and terminial tracks and carry the pig, scrap and coke from the bins in the storage yard, pass over track scales and thence to a 2-ton pneumatic elevator, that conveys them to the charging floor.

The charging floor is constructed of steel plate and is laid out with storage tracks served by a small transfer table, so that a number of loaded trucks can be stored. The cupolas are charged by machine. A Sturtevant positive blower, direct-driven by a 50-horsepower, alternating current motor, supplies blast at 14-ounce pressure. A room on an



PLAN VIEW OF THE GRAND TRUNK PACIFIC GRAY IRON AND BRASS FOUNDRY AND SIDE ELEVATION AND PLAN OF THE CHARGING FLOOR

130 feet, with a cleaning annex, 60 x 80 feet. The building is divided into one center bay, 70 feet wide, and two side bays, 30 feet each. The main molding floor is in the 70-foot bay and is commanded by a 15-ton electric traveling crane, equipped with a 5-ton hoist. The crane itself is capable of lifting at a speed of 10 feet per minute and the hoist at 30 feet, the traveling speed of the crane being 200 feet per minute. Similar cranes are installed in the machine shop. An industrial track encircles the main bay, which is

nates in one of the core ovens, of which there are three, constructed by F. Hyde & Co., Montreal. The largest is 12 x 12 x 9 feet, has racks on its three walls and is used for baking cylinder and other large cores. The other two ovens have racks on two walls only and are used for miscellaneous cores. The firing pit for the three ovens is in the cupola room, which is 30 x 40 feet, containing a No. 7 and a No. 9 Whiting cupola, with capacities of 11 and 16 tons per hour, respectively. The trucks which operate on indus-

elevated platform below the charging floor contains the blower machinery and below this platform is a 36 x 60-inch cinder mill, driven by gearing from a 5-horsepower motor.

A fully equipped brass foundry, 80 x 30 feet, is situated on the south side of the building. This shop is self-contained, making its own cores and drying them in a Hill & Griffith portable core oven. The shop contains four coke-fired brass furnaces, for which blast is supplied by a 24-inch, belt-driven blower, made by the Canadian Buffalo Forge Co.

Other equipment includes a 1-ton hand traveler, blower, wet and dry tumblers, band saw, sprue cutter and double emery grinder. This machinery is driven from a line shaft operated by a 10-horsepower motor.

While most of the molds are made by hand in the gray iron foundry, grate bars and similar patterns are molded on a Buch's gravity molding machine.

The 80 x 60-foot cleaning annex contains a 5-ton electric traveling crane that serves the entire floor. A standard-gage track extends into this department and castings can be loaded directly from the floor onto cars. An industrial track connects with all departments. The grinding wheels, tumbling barrels, etc., are all provided with dust hoods and exhausters.

A long, covered shed north of the foundry is used for the storage of pig iron, scrap, coke and core sand. This shed is divided into bins that are filled from cars on a nearby, standard gage track. To obtain raw material it is never necessary to go out into the open air, a considerable advantage in severe winter weather. Molding sand is stored behind the toilet rooms, the bins being filled direct from cars. Compressed air is piped through the foundry for the chipping hammers and sand rammers.

Jar-Rammed Guard Rail Molds

THE superiority of jar-ramming over hand molding practice is specially apparent in making large castings with comparatively thin sections, where the amount of sand to be rammed per pound of metal is considerable. A great deal of work of this character is handled by the Edgar Allen American Manganese Steel Co., Chicago Heights, Ill., in the production of manganese steel frogs, crossings and special track work. A large jarring machine built by the Herman Pneumatic Machine Co., Zelienople, Pa., is used and considerable economies over hand molding have been effected.

Fig. 1 shows a number of jar-rammed guard rail molds and Fig. 2 illustrates a drag with pattern in place on the table of the machine. The latter is 10 feet, 4 inches long and 3 feet, 4 inches wide, the flasks, which are cast iron, having nearly the same dimensions. The casting is about 8 feet long. With the aid of the machine six men set-up and pour-off from 30 to 32 molds per day. The actual ramming operations require about three minutes in the case of a cope and four minutes for a drag; usually about 120 bumps are given the former and about 160 the latter, the drag taking more time on account of its containing a larger quantity of sand.

The Patterns

The patterns are made of aluminum, brass-faced; the drag pattern is shown in the chain at the rear of Fig. 1 and the cope pattern is at the left in the same illustration. The latter is recessed to form the large green sand core that extends from the cope into the drag portion of the mold. Each pattern is heavily backed with 4 x 4-inch wood blocks, as illustrated in Fig. 2.

Ordinary molding sand with clay binder is unsatisfactory on account of the cutting action of molten manganese steel, and sand with a high percentage of silica is employed instead. Each mold has two gates, one at each end, and the castings are poured two-up from a large and small ladle simultaneously. Large pouring basins surmount each runner, as indicated in Fig. 1. Connected with the middle of the mold is a 1½-inch riser which simply serves as a blow-off and to notify the ladleman when the mold is full.

After the castings are poured, they must be annealed, but before this is done it is sometimes necessary to give them a preliminary heat-treatment to neutralize shrinkage strains. Usually they

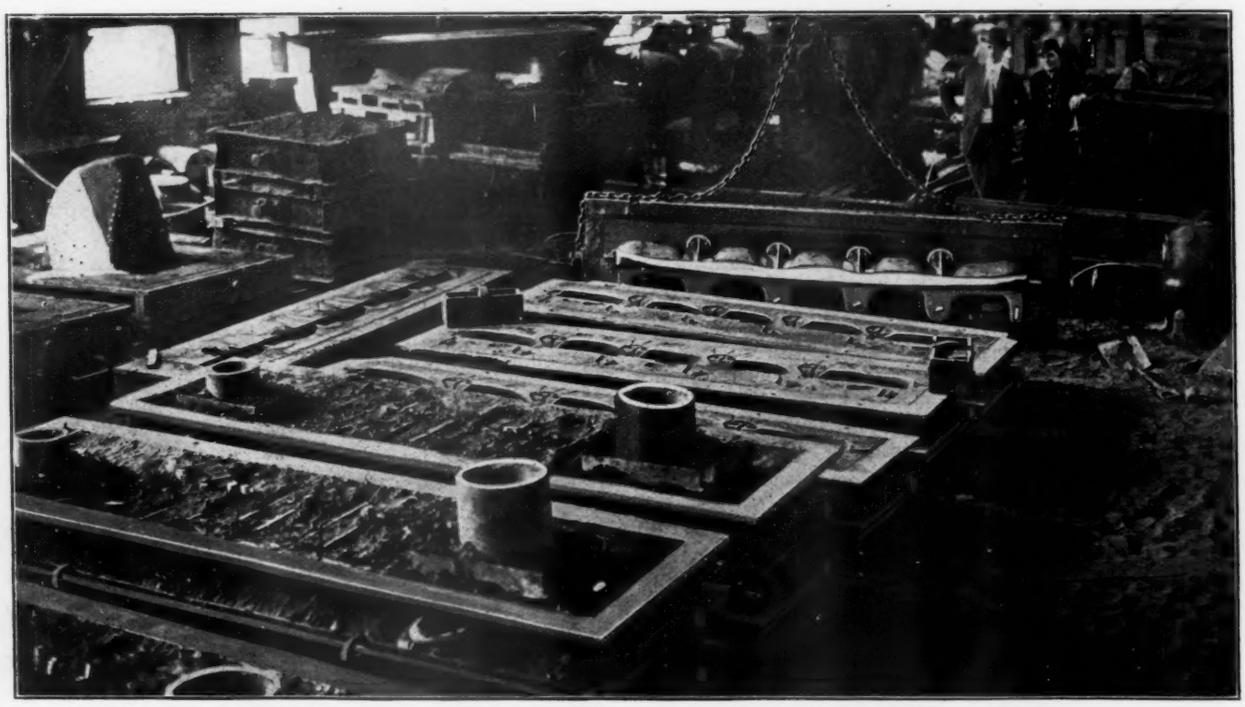


FIG. 1—GUARD RAIL MOLDS WITH THE PATTERN IN THE BACKGROUND

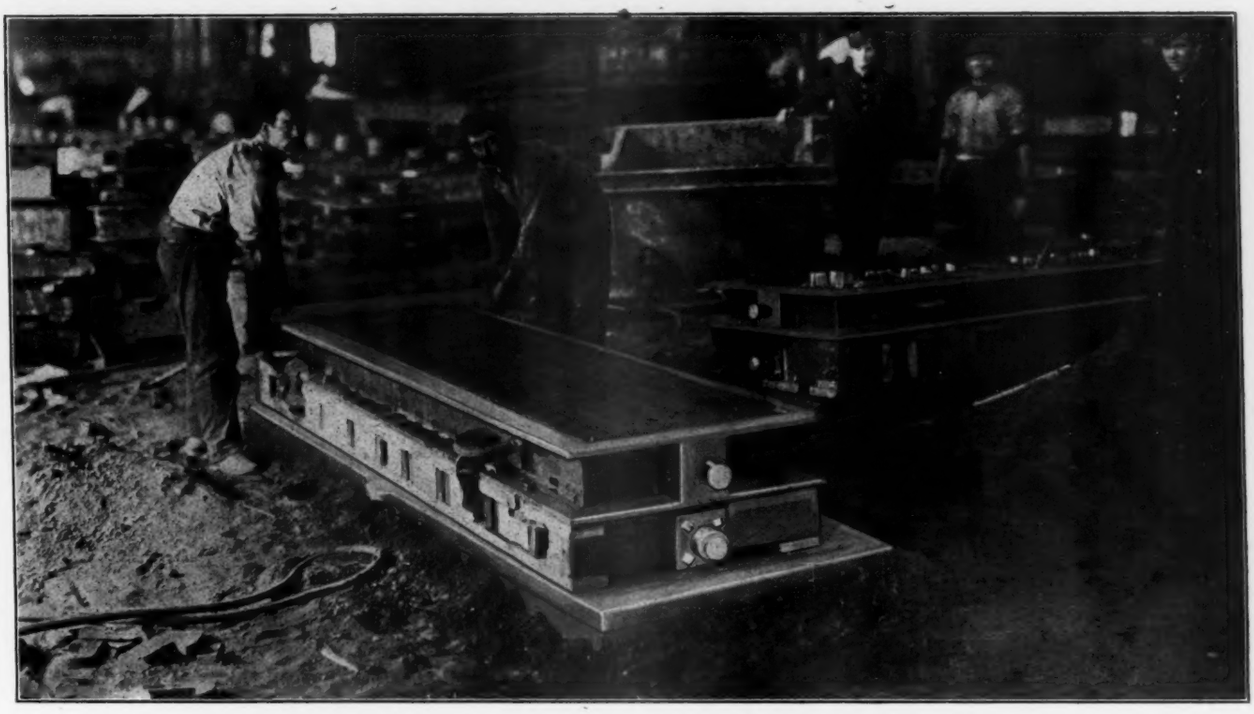


FIG. 2—MOLDING GUARD RAILS ON A JAR-RAMMING MOLDING MACHINE

are allowed to cool and are then carefully annealed to make them ductile and tough. The plant is provided with a number of coal-fired annealing ovens and quenching tanks for properly taking care of this feature of the work. The largest oven is 18 x 24 feet in size with a concrete tank, Fig. 3, of corresponding dimensions. This oven is provided with a car of 20 tons capacity, on which the castings to be annealed are loaded. When the annealing process is completed, the oven door is opened and the car is hauled out with its burden of red hot material. It is then picked up bodily with two traveling cranes and is immersed in the cooling tank. The annealing temperatures are not excessive, being from 1,600 to 2,200 degrees Fahr., and the time required varies from four hours to 24 hours, depending on the size and the character of the castings.

Record Crucible Furnace Run

Furnace No. 2 in the crucible steel plant of the Columbia Tool Steel Co., Chicago Heights, Ill., has made a wonderful record for continuous operations. The first heat was made July 13, 1909, and six heats a day, except Sundays and holidays, have been made regularly to April 24, this year, a period of 3 years, 9 months and 11 days. During this period, the furnace melted 6,290 heats, refining 9,435 tons of tool steel. This plant contains two 30-pot crucible furnaces in charge of W. J. Mathews, melter. Notwithstanding this continuous run, the furnace is in fair condition, although several new tops have been added, due to the wear resulting from dragging the pots over the top layer of bricks, and on Jan. 18, this year, a new middle wall was built. However, no other repairs have been made.

In design and construction, these furnaces differ somewhat from those employed in the Pittsburgh district. Owing to the recurrent spring floods, the crucible furnaces in that section of the country have been built largely above the ground, out of reach of high water. The furnaces in the plant of the Columbia Tool Steel Co., on the other hand, are built largely in the ground and the melting floor is only 31 inches above the floor level. This type of construction undoubtedly insures a more uniform distribution of heat throughout

FIG. 3—HOT CASTINGS BEING TRANSFERRED FROM THE ANNEALING OVEN TO THE QUENCHING TANK

the furnace and expansion and contraction arising from the cooling of the exterior are reduced to the minimum.

These furnaces were built on a foundation of concrete, 12 inches thick, which eliminated any danger from settling. The partition wall between the gas and air tunnels are 18 inches thick, thereby preventing leakage, although these tunnels generally are only 12 inches in thickness. Throughout this period the fire brick was almost continuously subjected to a temperature of 3,000 degrees Fahr. When this type of furnace was first introduced in the United States, a run of four or five weeks was considered satisfactory and when this was increased to four or five months, it was believed that a record had been established.

Ancient and Modern Methods of Buffing

By Seymour W Rowsbar

BUFFING, as we understand the term today, was originally accomplished by the use of buffalo or wild ox hide and the treatment was entirely by hand. The metals being solid, they were first roughed-off with such abrasives as were obtainable at that time, and the final luster was imparted by buffing and burnishing. The term *buffing*, no doubt, is of Spanish origin and can be traced back to the use of the hide of the wild ox or buffalo for producing a luster upon the surface of metals, wood, ivory, etc. Buffing is disagreeable, dirty work, yet a careful, skillful buffer, working under favorable conditions, is one of the principal operators in the manufacture of all goods demanding a high metallic luster. He is also an indispensable contributor to the superior appearance of the best finished product. In many shops, work is pronounced practically finished, as far as inspection is concerned, when it leaves the polishing room, or perhaps when ready for polishing, the plating and buffing operations being regarded of little importance and a brilliant surface satisfies, whether it is of a durable nature or otherwise. This is and always has been a great mistake on the part of the manufacturer. There are various factors which contribute to the production of first-class electroplating, such as good polishing, absolutely clean surfaces, a soft, heavy, uniform deposit of good color, and last but by no means least essential, careful, systematic buffing.

Value of a Good Operator

A good buffer is of equally as much value to the plating and polishing department as to the buffing department, as it is within his power to cover up or make less conspicuous certain defects originating in these departments or to produce a finished article with every possible degree of perfection. The most skillful buffers of today are men who were trained by conscientious foremen and not left to their own resources when given a new piece to finish.

There are certain fundamental principles in connection with buffing, which must be considered before one may become thoroughly expert at the work. While buffing poorly polished metals will not make a first-class finish, it is easy to make one-wheel work on tubing appear sufficiently well finished to answer the usual requirements for commercial purposes, or surfaces such as stove parts. Competition is now so keen that the reduction to one-wheel operation in polishing means a great saving in a year on an article. With the polishing reduced to one-wheel operation, the buffer should be informed as to the direction of the wheel mark with respect to the work. With tubing he would always know, but for flat or shaped work the various methods of handling should be explained, as it is often impossible to detect the direction of the final wheel marks after plating. For this reason, some understanding must be arrived at between the polisher and buffer, or the latter often will be at a loss to know how to handle certain pieces in order to produce best results.

Mutual Aid System

When polishers perform two or three or more wheel operations on a piece, they seldom adhere to any definite rule as to which direction the final operation should take unless trained to do so. In order to insure the best possible results by this mutual aid system, the plater necessarily is responsible in no small measure, as a soft, heavy deposit is essential in order that the buffer may buff across the final polishing and lay the metallic scales down in such a way as to make the surface appear free from scratches or waves. This procedure distorts the surface of the deposit, but if the metal is soft and heavy, the effect will be satisfactory and the durability of the deposit in no manner suffers.

The idea of spreading a metallic deposit is not new and proved successful with the duplex or acid copper deposits several years ago and has since been practiced by firms famous for the excellence of their electro deposits of copper, nickel and brass; but each operator does his part in a manner generally understood by those preceding and following him in the handling of the work, and the result is a splendidly finished product.

The usual difficulty is in getting a suitable deposit of metal to buff. Nickel deposited from a bath showing a slight excess of acid and by an electric current of large volume at moderate tension, will invariably spread nicely. The conductivity and metallic strength of the bath should be closely watched and kept constant. Brass and cyanide copper baths should not be allowed to become too low in cyanide as a deposit from a cyanide solution, which is deficient in free cyanide, is extremely difficult to color and will not spread. An intense current should be avoided and the solution should be maintained at about 6 degrees Baume for cast iron or 10 degrees for sheet iron, wrought iron or steel. Every reasonable thing should be done to make the equipment and the working conditions in the buffing room the best possible. One of the largest and most powerful fans ever made by a certain fan manufacturer has been in operation for the past two years in a shop which is noted for its dirty buffing department, the conditions being simply the result of faulty suction because of improperly constructed pipes from fan to hoods.

Dust Removal

Dust removing is one of the most difficult problems connected with the buffing department and the designing and installation of fans and suction pipe should be entrusted to only thoroughly competent, practical men. Any sheet metal worker may be able to construct a hood and the necessary lengths of pipe from drawings made by a foreman, but in 95 cases out of every 100 the resulting system is defective. There are many plants throughout the country today using more than double the power that would be required were the hoods and fans of proper design and the connecting pipes properly installed. It is not sufficient to have the largest and

best fan. It must be applied in a scientific manner or it will prove little better than useless. The buffing department should also be well lighted as it is impossible for a man to buff any metal properly in a dark corner with his eyes filled with greasy lint. The surrounding walls should be white. Outside brick walls from which reflected light may come should be whitewashed or painted.

The lathes should be heavy and kept in true running order, free from vibration. Cloudy, lusterless spots on the buffed article invariably result from over-heated work during buffing, either before or after plating. Machines running at too high speed are also the cause of this difficulty. A speed of not over 2,500 revolutions per minute should be sufficient for all ordinary classes of work. Wheels of proper size used on lathes at this speed will do the work more economically than when run at a higher speed, not only in reduced cost of power, but a material saving in buffing compound will result. The foreman should consider the criticisms of the men with reference to buffs and should endeavor to select only those which prove especially adapted to the work. The aversion to sewed buffs is fast disappearing, and such buffs are now used for many classes of work which formerly were considered impossible to finish on them. A buff to be efficient must stand up and present the composition coated edge to the work, and practically no threads should be torn out, but should wear away gradually. The material must be uniform in quality and not buckle when in operation.

Buffing Composition

Various buffing compositions of lime and mineral oil are now being introduced, and the experienced buffer quickly detects the inferior preparations. A composition of pure Vienna lime and animal greases will invariably produce a greater luster with less effort and thereby will enable the buffer to increase his output. Animal fats cause the lime to adhere to the wheel better and the work is finished cleaner. The superior finish produced by certain well-known brands of buffing compounds is largely due to the animal grease and purity of the lime used. There is a peculiar dexterity required in expert buffing which may only be acquired by continued practice. Polishers seldom make expert buffers, as in polishing they become accustomed to exerting considerable pressure upon the piece being treated, and this pressure usually proves disastrous to electro-deposits. Many firms are disposed to reduce the operations in the polishing room and leave the problem of obtaining a fair finish to the plater and buffer, without giving the latter credit for the extra labor and attention. This is a great mistake and is the direct cause of a large percentage of the poorly finished commercial products of today.

Burnishing

Until recently, silver deposits were burnished, but now silver is buffed directly following the drying treatment without being scratch-brushed, and in many cases the work is done on the piecework plan. What can be expected other than dissatisfied customers? Silver, if buffed, should be first scratch-brushed and if the article is worthy of a deposit of silver, we contend it should justify the expense of burnishing. Burnishing removes no metal, but hardens the deposit. Buffing removes some metal and the coating is rendered uneven or patchy. This is not apparent, perhaps, for months, but eventually proves true.

As in all manufacturing operations, buffing affords an excellent field for motion study. The elimination of useless movements results in greater efficiency. Some men will produce better results upon a piece of work by one application to the wheel than another will by repeated efforts. Overlapping is to be avoided as much as possible and the proper amount of composition to effect just the proper color requires study. The rapid development of the various ball burnishing methods has greatly reduced the amount of buffing wherever the ball process has been tried, as the work is uniformly burnished at comparatively small expense. In fact, a vast amount of small work is being treated both before and after plating by the ball burnishing process and the finish very often is superior to the finish obtained previously on the same work by polishing and buffing. These latter operations, however, will always be required on the majority of metal work receiving electro-deposits and buffing will never be of less importance in the production of superior finishes.

Chicago Convention Preparations

DURING the past six weeks considerable progress has been made on the plans for the foundry convention and exhibition which will be held in Chicago, Oct. 10 to 17. Charles A. Plamondon, president of the A. Plamondon Mfg. Co., has been chosen chairman of the general committee in charge of arrangements. The balance of the committee is now being organized. Mr. Plamondon has been connected with the foundry business in Chicago for many years and 20 years ago, in 1893, was the first president of the Western Foundrymen's Association, which was the pioneer foundry organization in the Chicago district.

A movement is under way to hold meetings of the National Founders' Association and the National Metal Trades Association in Chicago in October at the time of the foundry convention. The executive committees of both associations have the matter under advisement and there is good prospect of satisfactory arrangements being made. The National Founders' Association usually holds its annual meeting in New York in November.

Reservations for space at the exhibition which will be held at the International Amphitheater, Forty-second and Halsted streets already exceed the total space utilized at any previous convention. Over 100 firms have signified their intention of exhibiting at Chicago and their aggregate requirements will exceed 50,000 square feet of floor space. A feature of the exhibit will be a large display by machine tool builders, from 25 to 30 of whom will be represented.

A pre-convention roundup will be held by the Chicago Foundrymen's Club at the Stockyards Inn, Saturday evening, June 7. It is expected that the chairman and members of the local committee will be present. A steak dinner and a special menu has been prepared. Arrangements have also been made for an attractive program, including music and speeches. "The Foundrymen's Chorus" will make its initial appearance in Chicago at the dinner.

Institute of Metals

The annual autumn meeting of the Institute of Metals will be held at Ghent, Belgium, on August 28, 29 and 30, in connection with the International Exhibition at that place. Among the important subjects that will be considered will be the report of the committee on corrosion.

The production of iron ore in the United States, in 1912, it is estimated will show an increase of from 25 to 32 per cent over the total of 1911. The aggregate tonnage last year is placed at 54,500,000, as compared with 43,550,633 in 1911.

DIFFICULTIES OF THE PLATER

The Reason Why and the Remedy

Steel Strike

A brass mat border which is to be nickel-plated has a zinc strip attached and we cannot get a good deposit on the piece because of streaks from the zinc. How may we overcome the trouble? Of what is a steel strike composed and how is it used?

The nickel solution you are using to plate the zinc strip is too acid and possibly is deficient in conducting power. Try neutralizing the acid with carbonate of nickel and increase the conductivity of the bath with ammonium chloride. When hanging the articles in the solution, make a connection with the negative pole of the bath before immersing the work in the solution.

A steel strike consists of 8 ounces of sal ammoniac and 20 ounces of sulphate of iron to a gallon of water; it is used with wrought iron anodes, the surface of which should equal or exceed the surface of the cathode, and a current at from 2½ to 3½ volts. A few minutes' deposit will produce a film sufficient to receive other coatings. Keep the solution strong and the current density low. Thick deposits have a cloudy appearance, and if an excessive current is employed, the deposit will be dark at the edges and will be liable to flake. If the anodes coat over, remove from the solution and scour.

Recovery of Silver

We desire some information regarding the recovery of silver from a silver plating solution.

There are several methods which are used for this purpose, the older process and possibly the one in most general use has the disadvantage of being dangerous unless great care is exercised and the operation performed in the open air or beneath an exhaust flume. This method is known as precipitation by muriatic acid. The potassium cyanide solution is decomposed and the silver precipitated as silver chloride. For large solutions, the method is not practical to the extent that the average plater can use it for small quantities.

Another method is to evaporate the solution to dryness and to fuse the residue in a crucible, thus obtaining a button of silver. This process is slow and also is more or less dangerous, as during the reducing process cyanogen fumes are liberated. No doubt there are many cases where these methods may be used satisfactorily, as they have been known for many years. The following method, however, is recommended for ordinary plating plant purposes and requires no special apparatus. It is simple and easy to perform and is practically as efficient as the more difficult processes:

Make up a quantity of saturated potassium sulphuret solution, or in other words, use all the sulphuret a given volume of water will dissolve. Add the sulphuret solution to the silver solution in small quantities. No immediate effect will be noticeable, but presently a brown color is produced which soon passes into a black, then as more sulphuret is added, the black portion, which is silver sulphide, settles to the bottom, leaving a clear solution at the top. Take some of the solution out in a bottle or glass at this stage and test for further precipitation. If required, add more sulphuret solution and continue until a test shows that the precipitation is complete. Then allow the solution to stand for 10 or 12 hours and the silver sulphide will settle to the bottom in a compact form and the clear solution may be siphoned off. After removing the clear solution, fill the tank with cold water, stir well, allow to settle and siphon off again. Repeat this washing three or four times, as in washing carbonates. It is not necessary to employ hot water for the washing, as cold water is equally as effective. After the washing in this manner, empty the silver sulphide onto a filter paper and wash again three or four times to facilitate the complete illumination of traces of cyanide solution. Then place the black sulphide in a glazed crock and cover with a solution of nitric acid and water in equal quantities. Stir the mass and place the crock on a sand bath or other safe heating device and warm the mixture. The sulphide will then go into solution as silver nitrate and become a grayish white if the sulphide has dissolved properly. Should a black substance continue in evidence, continue the heating for some time and add a little more nitric acid.

When the black residue has disappeared, the solution is diluted with an equal quantity of cold water and after settling, it is filtered. The clear solution now is silver nitrate and the silver is precipitated with sodium chloride and silver chloride is obtained. The chloride may easily be washed and dried or dissolved again to produce a new plating solution, or it can readily be reduced to the metallic condition, if sufficient heat is available. The chloride first dried is mixed with about five or six times its weight of sodium carbonate and a small quantity of nitre, and is charged into a hot, glazed crucible and a red heat maintained during the effervescence of the mass. When the mass becomes quiet, pour out into a warm mold. The addition of nitre serves to facilitate the oxidation of other metals which may be present. By remelting the silver and pouring into cold water, granulated silver is produced, which is white and clean.

Lute for Plating Tanks

What is the best lute to use for assembling slate plating tanks? These are to be used for cold nickel, silver and copper-plating. The tank we have is luted with litharge and glycerine, but this compound leaks. The tank cannot be taken apart without damage and we would like to know whether there is some kind of lute of the consistency of putty that can be used without affecting the plating solution.

Clean the joints thoroughly, removing the litharge and other substances, and apply a coating of thick Mogul paint with a stiff brush, working the paint well into the joint. Cover the joints with strips of heavy factory cotton and apply a coat of this paint over the cloth, covering the edges well. Permit this to dry 24 hours and then apply a second coat over the cloth and allow to dry. This will render the joint absolutely tight and is acid and alkali-proof, and, furthermore, will not affect any plating solutions. This paint is the most efficient lute for slate tanks or any other tank and you will find it useful for various purposes in the plating room. It may be purchased from the Mogul Co., 429 Sixth avenue, New York City. This is the only lute which we have ever used which proved entirely satisfactory for slate or glass tanks used for plating purposes and we have no hesitancy in recommending it.

Application of Chemistry in the Plating Room--IV

Various Methods for the Determination of Nickel in Solutions Are Presented With Methods of Figuring Problems

By E P Later

ON ACCOUNT of its many excellent properties, both physical and chemical, nickel finds a very wide application in electroplating. The ease with which it may be deposited, its splendid appearance when buffed and the permanence of the coating, even under adverse conditions, make it of the utmost value for application where appearance is an important factor. It affords, also, a very good protection from corrosion, so that it may be used in almost any case where appearance and protection are to be considered.

In many of its characteristics, nickel resembles iron. When pure it is quite lustrous, silvery white in color, but with a slight gray tinge. It is hard and heavy and melts at about the same temperature as iron; when alloyed with other metals the fusing point may be lowered.

Chemical Properties

Regarding its chemical properties, nickel is soluble in dilute nitric acid and dissolves slowly in hydrochloric and sulphuric acid. Strong nitric acid produces a peculiar phenomenon, rendering it passive or insoluble. Just what the action is, may be open to some doubt, although it has been suggested that a thin film or oxide is formed, which prevents further action, or that the metal receives an electric charge.

There are a number of ways in which nickel may be estimated and perhaps the simplest is by the use of a standard solution of potassium cyanide. The solution described in the preceding article for the estimation of copper may be used. It will be necessary to calculate or determine its value in terms of nickel sulphate, Ni SO_4 . $7H_2O$, or another salt of nickel which finds quite extensive use among platers, namely, the double sulphate of nickel and ammonium, Ni SO_4 . $(NH_4)_2$ SO_4 . $6H_2O$. These are known as single and double nickel salts, respectively. At one time the double salts were used almost exclusively, but lately the single salts have been coming more and more into favor among good platers. Laying all prejudice aside, the former does not give any better deposit than the other, while its comparative insolubility is a positive disadvantage. With the single salts a much more concentrated solution can be made, which means that a greater rate of deposition can be obtained, thereby shortening the plating time.

Standardization of Cyanide Solution

Prepare a standard solution of nickel, sulphate, Ni SO_4 . $7H_2O$, containing 18.13 grams per litre. Take out 10 c.c. of this solution with a pipette and run it into a beaker. Add ammonia water slowly until the green precipitate of nickel hydroxide is not quite dissolved. If a deep blue solution forms from excess of ammonia, the hydroxide will not be precipitated.

Add the cyanide solution from the burette slowly until the precipitate just redissolves and a clear yellow solution results.

Theoretically, 1 c.c. of cyanide solution (16.82 grams of litre) = 0.0181 grams of nickel sulphate, or 0.0254 grams of nickel ammonium sulphate.

Sinse 1 c.c. of nickel solution (18.13 grams to a litre) contains 0.0181 grams of nickel sulphate, 10 c.c. should require $0.181 \div 0.0181 = 10$ c.c. of cyanide solution. In any case the value of 1 c.c. of cyanide solution in terms of either salt may be found by dividing the number of grams of salt taken for test by the number of cubic centimeters of cyanide solution required.

Thus, if 10 c.c. of nickel solution were taken, representing 0.1813 grams of nickel sulphate and 9.5 c.c. of cyanide were required, the calculation would be as follows: $\frac{0.1813}{9.5} = 0.0190$. Therefore, each cubic centimeter of cyanide solution is equivalent to 0.0190 grams of nickel sulphate.

If it is desired to express the value of the cyanide solution in terms of metallic nickel, it may be found by multiplying the value in terms of nickel sulphate by 0.209.

For example, if 1 c.c. of cyanide is equivalent to 0.0190 grams of nickel sulphate, $0.0190 \times 0.209 = 0.004$, which is its value in terms of nickel.

As was noted in the case of copper sulphate, mentioned in the preceding article, nickel sulphate also crystallizes with several molecules of water of crystallization. Ordinarily, seven molecules are present, so that in all of the above calculations the formula of the salt has been taken as Ni SO_4 . $7H_2O$, possessing a molecular weight of 280.86.

To determine the amount of nickel in nickelplating solutions, pipette 10 c.c. of solution to be tested into a beaker. Do not dilute. Add ammonia slowly to form a green precipitate, but not quite enough to form a clear blue solution. Place the beaker on a sheet of white paper and add slowly from the burette the standardized solution of potassium cyanide. The yellow precipitate of nickel cyanide which forms will redissolve when an excess of the reagent has been added. The titration is continued, therefore, until one drop of reagent renders the solution clear and of a yellow color.

Calculation.

If the cyanide solution is of such strength that each cubic centimeter is exactly equivalent to 0.0181 grams of nickel sulphate, the content of the plating solution in ounces per gallon of this may be found by multiplying the number of cubic centimeters of cyanide required by 13.3.

If it is not of this strength, the ounces of nickel sulphate per gallon may be found by the following formula: $\frac{Y \times Z \times 100}{7.5}$ where Y equals the number of c.c. of cyanide solution required and Z equals the value of one c.c. of cyanide solution in grams of nickel sulphate or nickel ammonium sulphate.

One nickel bath cannot be used for all kinds of plating, or at least it does not work as efficiently as it should, and each plater, therefore, should determine the solution which works best under his conditions and requirements. Then, by knowing or determining the amount of nickel salt in solution it is easy to keep it at full strength by making an analysis every day or two and making up any deficiency of metal.

In strengthening a weak bath, nickel in the form of the sulphate or basic carbonate may be added. The latter is also used when too large an amount of free acid is present. Basic nickel carbonate has approximately the following composition: 2 Ni Co_3 . 3 Ni $(OH)_2$. $4H_2O$ with a molecular weight of 587.51 and contains, therefore, about 9.9 per cent of metallic nickel. Crystallized nickel sulphate, when pure, contains

20.89 per cent of metallic nickel; the double nickel-ammonium sulphate contains 14.85 per cent of metal.

For those who possess the necessary apparatus, the electrolytic determination of nickel may afford an easy and convenient means of checking the solutions.

To determine nickel in plating solution by electrolysis, the platinum spiral and cone or dish should be thoroughly cleaned, dried and weighed. Twenty cubic centimeters of nickel solution are taken out by a pipette and run into the platinum dish or beaker. Four grams of pure ammonium sulphate and about 35 c.c. strong ammonia should be added, after which the spiral is put in and the cone placed over it, taking care that they are well-insulated from each other. The cone or dish is connected to the cathode or negative side of the source of current, the spiral being made the anode, and the solution electrolyzed with a current strength of 0.5 to 1.5 amperes and about 3 volts.

Electrolytic Method

When a drop of ammonium sulphide does not produce a dark coloration when added to a few drops of the solution, all of the nickel has been deposited. The cone and spiral are then carefully removed, washed well with distilled water and finally dipped once or twice in strong alcohol dried in a hot oven, 212 degrees Fahr., or over a gas flame and again weighed.

The increase in weight is the amount of pure nickel contained in the amount of solution taken, usually 20 c.c. This weight of nickel, when multiplied by 50, gives the grams in one litre of plating solution. It may be expressed as ounces per gallon by multiplying by 0.133.

If the nickel bath contains large quantities of organic acids or compounds, it is best to take 20 c.c. of solution, add sodium sulphide until precipitation is complete, then filter and work thoroughly with distilled water and dissolve in nitric acid. Any precipitate adhering to the filter paper may be removed by putting a few drops of the acid on it, then washing with distilled water. A small quantity of sulphuric acid, 5 to 6 c.c., should now be added to the nitric acid solution and the whole evaporated, preferably over a water bath, to expel all nitric acid. The residue is then electrolyzed as before.

Another method of determining nickel which has been developed within the last few years is so easy of manipulation and gives such accurate results that it is well worthy of note. It involves the use of an organic compound known as Dimethyl Gloxine, the nickel being precipitated in a solution containing a slight amount of free ammonia, and coming down as a bulky precipitate of a splendid red color. This is filtered off, washed, dried at 212 degrees Fahr. and weighed. For those who possess a balance and wish an accurate determination, it will be found of great service.

Aside from the balance, the only new equipment required is the reagent and a Gooch crucible, with some finely shredded asbestos. All may be obtained at any supply house. A saturated solution of the former is made in 85 per cent Ethyl, grain, alcohol. The Gooch crucible differs from ordinary porcelain crucibles mainly in the fact that it has a perforated bottom.

The asbestos should be shaken up with water to form a heavy suspension. The crucible is then washed clean, inside and out, and the asbestos poured through it until a compact layer is formed on the bottom. For this particular analysis, it does not have to be very thick, since the precipitate is so bulky that there is little danger of it running through. If a suction or filter pump is available, it will assist greatly in hastening the operation and preparing a compact mat which will not loosen after it is dried. As a suggestion, the layer of asbestos should not be much thicker than absolutely necessary, as the thinner it is the quicker it filters. Ordinarily, it should be about 1/16 inch or over.

After the mat has been freed from water as thoroughly as possible, the crucible should be dried for an hour at 212 degrees Fahr., then placed in a desiccator or under a beaker until cool and weighed. The drying and weighing should be repeated until a fairly constant weight is obtained. It should be remembered that incorrect results are generally obtained when articles are weighed while very warm; also, many things, asbestos, for example, tend to absorb water very rapidly and increase in weight upon exposure to the air after drying. Therefore, weighings should be made as soon as the objects have cooled to nearly room temperature, while covered with beaker.

Nickel in Plating Solution

To determine nickel in a plating solution ten cubic centimeters of solution are taken out by a pipette, run into a beaker and diluted to 75 or 100 c.c. As a precautionary measure, it is best to add a small amount of tartaric acid, 0.3 to 0.4 grams, to keep any iron in solution when making alkaline with ammonia. The solution is now made almost neutral with ammonia, then heated nearly to boiling and the alcoholic solution of Dimethyl Glyoxine added, a few drops at a time, stirring thoroughly, until the nickel is completely precipitated, which is shown when a drop produces no further action. Ammonia is added until the solution has a slight but distinct smell to it. It should be allowed to stand a few moments, then filtered through a Gooch crucible which has been previously prepared and weighed as described. The precipitate should be washed several times with hot water, taking care not to tear up or disturb the asbestos mat, and the crucible finally dried at 220 degrees Fahr. for an hour. It should be allowed to cool in a desiccator or under a beaker, and then weighed.

Calculations

The increase in weight of the crucible is due to the red precipitate, nickel Dimethyl Glyoxine, $(CH_3)_2C_2(NO)_2Ni \cdot (CH_3)_2C_2(NOH)_2$. This has, therefore, a molecular weight of 288.83 and contains 20.31 per cent of nickel. Since 10 c.c. were taken for analysis, multiplying the increase in weight by 100 gives the weight in grams of metal in the form of nickel Dimethyl Glyoxine present in 1,000 c.c. of solution. Multiplying this by 0.133 expresses it in ounces per gallon, and by 0.2031 reduces the result to metallic nickel ounces per gallon. To save time, the increase in weight of the crucible, when 10 c.c. are taken, may be multiplied by 2.70, which will give the same result as before.

Ordinarily, the titration with cyanide will give results which are accurate enough for all maintenance purposes. It is a very good idea, however, to determine pretty definitely the exact metallic content of the nickel salts purchased, for only when this is known can the plater calculate the correct amount to be added to the solution. Also, each new shipment of material should be examined, for there is no other easier or more certain way for a person to find out whether he is getting what he is paying for. For all inspection purposes, the electrolytic or Dimethyl Glyoxine methods are to be preferred to the other.

The determination should be made as follows: To estimate the nickel in nickel salts by electrolysis, about 2 grams of the salt are weighed into a beaker, dissolved in distilled water and the solution made strongly alkaline with ammonia. The volume is then made up to 150 c.c with distilled water and the platinum spiral and cone are put in place. These should be cleaned previously, of course, and the cone or dish weighed. The cone and spiral should now be connected to the negative and positive sides, respectively, of the battery or other source of current and the solution electrolyzed with a current ranging from 0.5 to 1.5 amperes at a

tension of 2.8 to 3.3 volts. If the solution is heated to 50 to 60 degrees Fahr., the process is much hastened. It may be assumed to be complete when a few drops give no precipitate with ammonium sulphide.

The cone and spiral are then removed without breaking the circuit and washed with distilled water. The cone is rinsed with strong alcohol and dried in an oven or by holding high above a gas or alcohol flame. When cool, it is weighed.

If two grams were taken, the increase in weight is divided by 2 and the decimal point moved two places to the right, which will express the result as per cent of nickel.

The cone or dish may be freed from the deposited metal by heating gently in a beaker with a sufficient quantity of nitric acid which has been diluted with its own volume of water.

By precipitation with Dimethyl Glyoxine, one gram of the salt is weighed into a beaker, dissolved in distilled water and the solution made up to about 125 c.c. It is then heated nearly to boiling and an alcoholic solution of the reagent added until no further precipitation takes place. A slight excess of ammonia is now added and after allowing to stand a few minutes, the solution is filtered through a Gooch crucible and the precipitate washed, dried and weighed as described.

The calculation may best be illustrated by the following example:

Wt. of salt .....1 gram
Wt. of crucible and precipitate...22.1083
Wt. of crucible alone 21.1237

Wt. of precipitate..... 0.9846

Since it contains 20.31 per cent nickel, $0.9846 \times 20.31 = 20$ per cent of nickel.

As a suggestion, a good grade of single salts should contain approximately 19 to 21.2 per cent of nickel, while the double salts will show 13 to 14.75 per cent.

The Awakening of the Patternmaker*

By James Glass

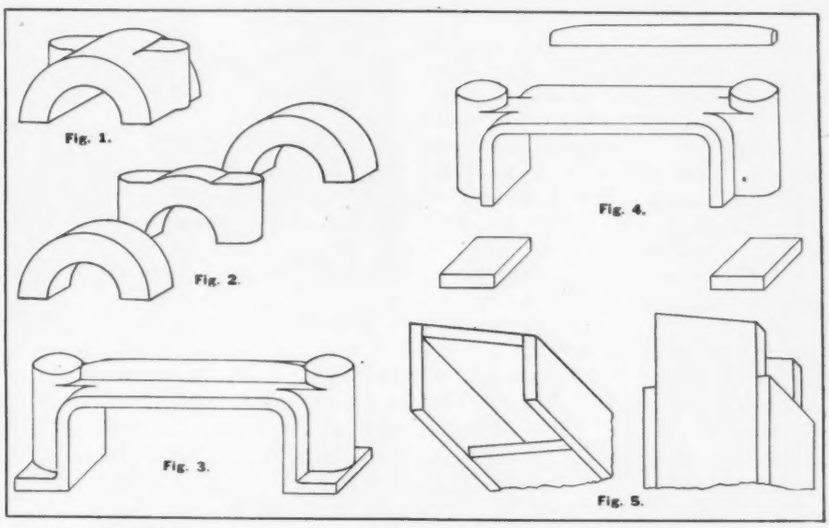
TO BUILD, is a physical endowment; to build wisely, is a moral attainment; to build correctly and quickly, which means cheaply, is a commercial necessity. The general lack of this constructive quality in workmen is best known to the progressive employer, whether in the foundry or in any other industrial line of activity. Nowhere in manufacturing is its influence felt and its usefulness more applicable than in the pattern shop.

Until recent years the pattern shop has been looked upon as a semi-productive department and the patternmaker as a kind of a half brother to the artist. This attitude of the employer no doubt has brought about the present condition with its lack of individual improvement and certainly has curtailed the patternmaker's value as a productive unit. To get at something that will be mutually beneficial to employer and employe alike, we must replace the artist with the mechanic, the impractical with the practical, the æsthetic with the constructive. Let us look along the benches in the pattern shop. We find the boy or the man laboring over a drawing. He has formed correct impressions as to the general outline of the work. He has concluded as to the best method of molding, but the construction of the pattern has him guessing. This stay in the progress of operation does not always apply to a big job, but very often to the small one, and the mode of construction is the determining factor in the price.

How often have we heard the patternmaker say, "If I had to make that job again, I would build it a different and an easier way;" but unfortunately for the employer, the same design is seldom used.

The mode of construction on a small pattern regulates the cost, and let me give a few simple illustrations in defense of the assertion. Consider, for example, a small cup, as shown in Fig. 1. Nine times out of ten the man will lay it out on a small block, saw out what he can on the band saw, and then complete the work, carving it out to the desired shape by hand. By constructing it, as illustrated in Fig. 2, we take full advantage of the saw reducing hand work to a minimum and saving at least 50 per cent in cost.

Another small pattern is shown in Fig. 3. To lay out this pattern on a piece of wood and to dig out by hand what cannot be reached with the saw means labor and time. Fig. 4 shows how easily this pattern can be made by dissecting it and doing the work almost wholly with the machine. The dissecting of a small pattern to facilitate its production does not always weaken it, as some might think, but as a matter of fact, more often strengthens it and for the majority of purposes quality of workmanship is not destroyed.



SUGGESTIONS FOR MAKING PATTERNS ECONOMICALLY

For a larger pattern, such as an ordinary bed plate, it may be decided to make a box pattern, coring out the inside. The usual mode of procedure on a pattern of this type is to get out two frames (top and bottom) to the given dimensions, half-lapping them at the corners, filing in between to the desired shape and height. Fig. 5 shows how, in building, we may form an enlarged lap with butt joints, simplifying

*Presented at the Buffalo convention of the American Foundrymen's Association.

construction and with a noticeable saving in labor. By gluing blocks in the corners and pieces across the joints inside while building, we have a pattern capable of withstanding any kind of abuse.

The Constructive Man

These illustrations are elementary to some patternmakers, but the general need of attention along these lines is obvious to those directly connected with the trade. I have talked of the man who makes every lick count, the man who makes a good piece of work with a large per cent less time on it than the other men in the shop, and with seemingly less effort—he's the constructive man. This is the man we are all looking for; the kind of workman we want. This is the man who does not have to be told every move to make, who increases production and decreases the cost of supervision. In him we have the evolution of the artist in the patternshop—the builder.

This type of workman is always respected by the boss and admired by his fellow workmen, respected by the broad-minded foreman because of his rapid completion of the work entrusted to him, and admired by the men because he is a leader.

But it is surprising how few realize and how seldom the attention is drawn to the fact that this man's master power is due to his natural or acquired constructive ability. It is more often concluded that his qualities originated in his having worked in a good many shops. While moving around is a help to the builder, adding to his confidence in generalities, it is far from being the key to his success as a workman. Some men might chase from shop to shop a hundred years and never climb above the ordinary.

Some years ago, while working in the pattern shop connected with one of our large plants, I wanted to confer with the foreman as to the method of building a large pattern and approached him with this purpose in view, but met with the response, "If you are a patternmaker, you ought to know." It was this indifferent attitude of one whose position warrants assistance rather than rebuff that made me seek the society of *Mr. Construction,* and he is the most willing and most able consulting engineer of my associates.

Jas. Naysmith, through his knowledge of mathematics, developed his steam hammer. The foundryman's success is due to an efficient business structure; the scientist's achievements are due to synthetic atomic and molecular work on stable and unstable compounds.

The patternmaker is apt to be looked upon by the manufacturer as artistic—a kind of a luxury. But the patternmaker of the future must and is going to have a different place in the industrial arena. With a constructive training his opportunities for promotion never were brighter, for through specialization in the other departments the sources from whence the bigger men were drawn have been partially destroyed, and the employer will look more to the pattern shop for this supply. Some of the patternmakers are alive to this fact and are preparing themselves for it. This is evident from the number we see as foundry foremen, superintendents and incumbents of other responsible positions.

Patternmaker's Awakening

The manufacturer is giving the best indication of encouragement; he is taking the patternmaker out of cellars and attics and is providing him with comfortable quarters; he is organizing industrial schools for his benefit, he is saying to the patternmaker, "there is the foundation—build." Constructivity, when the seeds are properly planted, is both interesting and fascinating. It teaches resourcefulness, and is a developer of originality. It attracts and it leads. It is a pleasurable means to a profitable end.

Should you find your pattern production lagging and are at a loss how to stimulate activity, before applying the megaphone method, thereby spreading a discordant feeling among the men, ascertain if a decided change cannot be made in the mode of *construction.*

Electric Furnace Plant

The Pittsburgh Electric Furnace Co., Vanadium building, Pittsburgh, has recently purchased a tract of land in the vicinity of Pittsburgh for the construction of a new plant, 60 x 150 feet, to be used for experimental purposes. The layout will include an ore testing plant, a commercial chemical laboratory and a complete electric furnace installation for melting alloys, such as brass, German silver, etc. A large number of furnaces, including practically every type on the market, will be available for making runs to secure data on comparative costs, losses, etc. The plans for this plant have been completed and the construction work is to be finished in about six weeks.

On account of the high prices the city is obliged to pay for castings, the establishment of a municipal foundry at Calgary, Alta., is being considered. The industries committee of the city council is favorable to the project.

Steel Casting Difficulties

Question:—In making crucible steel castings which have hubs, shrink holes frequently occur at the junction of the casting and the hub. We would be pleased to have you furnish us with a good mixture for soft steel, and we also would like to have several mixtures for other grades. We have been making chisels, the cutting edges of which give satisfaction, but the heads frequently chip and break off from the blows of the sledge hammer.

Answer:—To prevent shrink holes, the heads should be fed by heavy risers and the angles formed by the junction of the hub and the castings should be rounded off in the mold. In the case of a heavy hub attached to a thin disc, the hub core should be shortened to within ¾ inch of the cope side of the hub and on the top of the latter the riser should be located, the same as if the hub were solid. This will permit the casting to be fed by a riser of suitable size. In the case of chisels, the heads should not be tempered to the same degree of hardness as the edges, and if they are, the temper later should be drawn. A steel mixture containing approximately 1 per cent of manganese has given satisfactory results for casting edge tools.

Rough Surface on Castings

By W. J. Keep.

Question:—We make light gray iron castings, but recently they are exceedingly rough, the surface having a pitted appearance. Can you assign a cause for this?

Answer:—The inference from this inquiry is that castings from the same pattern formerly were smooth. The rational method of overcoming this difficulty is to see what changes have been made and to return to former conditions. Ascertain whether there have been any changes in the iron mixture, the grade of coke, facing or molding sand. Your foundry may have been cold, and if the patterns were cold the sand would stick to the patterns. This condition, of course, disappears when the weather becomes warm. In addition, the patterns may have become dirty. The difficulty should be easily located by your foreman.

John C. Wiarda & Co., Brooklyn, N. Y., are manufacturing nickel anodes and their plant has been completely rebuilt for this purpose. In addition to the manufacture of nickel anodes, zinc carbonate, copper carbonate, copper sulphate, nickel salts, potash and a full line of platers' chemicals are manufactured.

The How of Composition Pattern Plate Making

This Process Simplified by the Use of an Aluminum Frame—How the Pattern and Match-Plates Are Cast

FOR all kinds of repetition work pattern and match-plates are being extensively employed, as they effect material economies in molding costs, whether used on molding machines, with hinged flasks or on the floor. On account of its low specific gravity, aluminum is an ideal metal for pattern plates and has almost entirely replaced cast iron and brass for this work. Plaster of paris, owing to the ease with which it can be cast, forms a cheap material for the reproduction of patterns in plate form. However, it is exceedingly brittle and patterns thus made are not durable and will not withstand the severe treatment to which they are subjected in filling an order involving thousands of duplicate parts.

To meet the demand for a material that can be cast as easily as plaster and which has all of the desirable properties of aluminum and yet is of sufficient strength to withstand repetition work, the Federal Foundry Supply Co., Cleveland, has developed a special composition designed for the production of both match-plates and pattern plates. This composition does not shrink when cast, therefore insuring the exact reproduction of the master pattern. Its specific gravity is slightly lower than that of aluminum and having slightly malleable properties projections cannot be broken off except by a severe blow. In addition, the material can be soldered and broken plates can be repaired easily in this way.

To ascertain the sagging point of this composition, a test bar was made, 10 inches long, 4½ inches wide and ½ inch thick, which was supported horizontally at either end in an oven. The temperature at which the first sagging was noticeable was 215 degrees Fahr., which is easily 100 degrees in excess of the atmospheric temperature prevailing in a casting plant, even when pouring off. Plates made from this composition, therefore, are proof against sagging at any temperature attained in the shop.

To facilitate the production of these plates, a special frame and method of pouring has been developed by the Federal Foundry Supply Co., which insures the reproduction of patterns in plate form at a minimum of expense. To insure lightness and strength, the frames are made of aluminum, recessed on the four sides to anchor the composition.

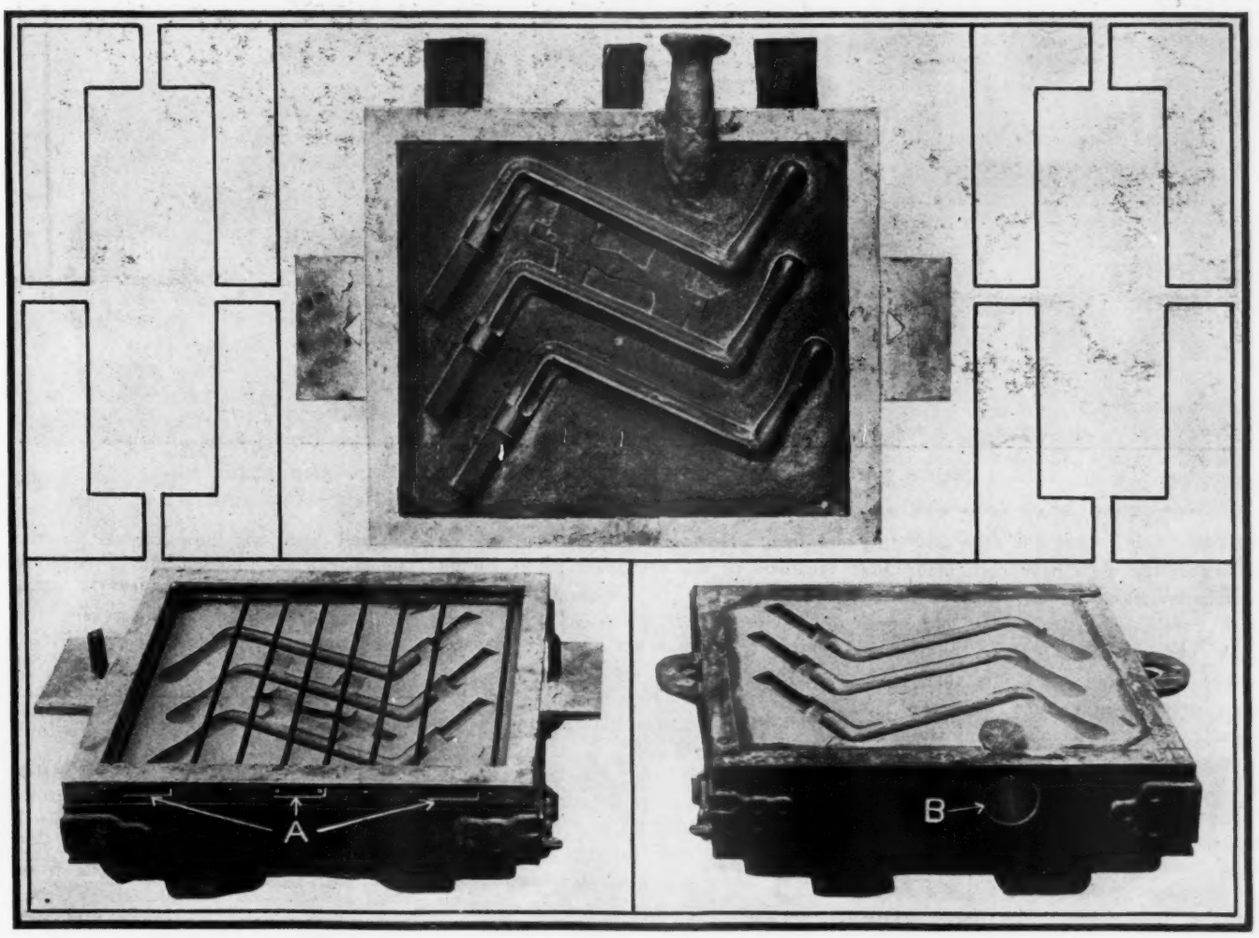


FIG. 1—COMPOSITION PATTERN PLATE CONTAINING THREE GRATE HANDLES. THE SPRUE AND RISERS HAVE NOT BEEN REMOVED

FIG. 2—REINFORCED ALUMINUM PATTERN FRAME ON DRAG HALF OF THE MOLD

FIG. 3—COPE HALF OF THE MOLD CONTAINING THREE GRATE HANDLES

The wood pattern for a frame with the core prints for the recesses in position, is shown at *A*, Fig. 4; *B* is the aluminum frame, reinforced with bars, which is used for making a pattern plate. However, if the pattern is irregular in contour, the frame is not strengthened in this way, as the anchorage in the recesses is sufficient to hold the composition in the frame. The stove door pattern plate, *D*, Fig. 4, on account of its irregular form was cast on a frame not containing reinforcing bars.

When making the mold for a composition match or pattern plate, either whole or split patterns can be used, although care should be exercised to obtain an accurate parting. A fine grade of brass sand is employed to insure a smooth finish. After the cope and drag halves of the mold have been made, the aluminum frame is carefully adjusted with reference to the flask pins and flask pin openings. Drag and cope halves of a mold containing three furnace grate handles are illustrated in Figs. 2 and 3. The aluminum frame is in position on the drag, Fig. 2. After closing the mold, it is set upright and the composition is poured through the sprue cut into the cope flask and shown at *B*, Fig. 3; at *A*, Fig. 2, are shown the openings in the frame for the risers for the composition. The risers insure the elimination of the gas and air, which if entrained might develop blowholes or spongy spots. The cope side of the pattern plate containing the three grate handles is illustrated in Fig. 1. The three risers are clearly shown, as well as the sprue. The plate required no other finishing than the removal of the sprue and the ends of the risers projecting beyond the end of the frame. It will be noted that the risers and sprue extend considerably above the frame. After closing the mold and setting it upright, a sand frame is placed on top of the flask and the sprue and riser extensions from the aluminum frame are cut into the sand in the sand frame.

The riser openings in the aluminum frame are spaced 4 inches apart and the number depends upon the size of the plate. The aluminum frame for this job was 5/8 inch thick, with the recess, ¼ inch. However, for large plates the thickness of the aluminum frame should be increased. The composition can be melted in any suitable vessel on a blacksmith's forge or other type of furnace.

A brass pattern for a stove door is illustrated at *C*, Fig. 4, and *D* is the composition pattern plate made from this pattern; *E*, Fig. 4, is a pattern plate containing four tea kettle spouts and the patterns on the drag side are partly discernible below the aluminum frame. The ends of the reinforcing bars in this frame also are shown.

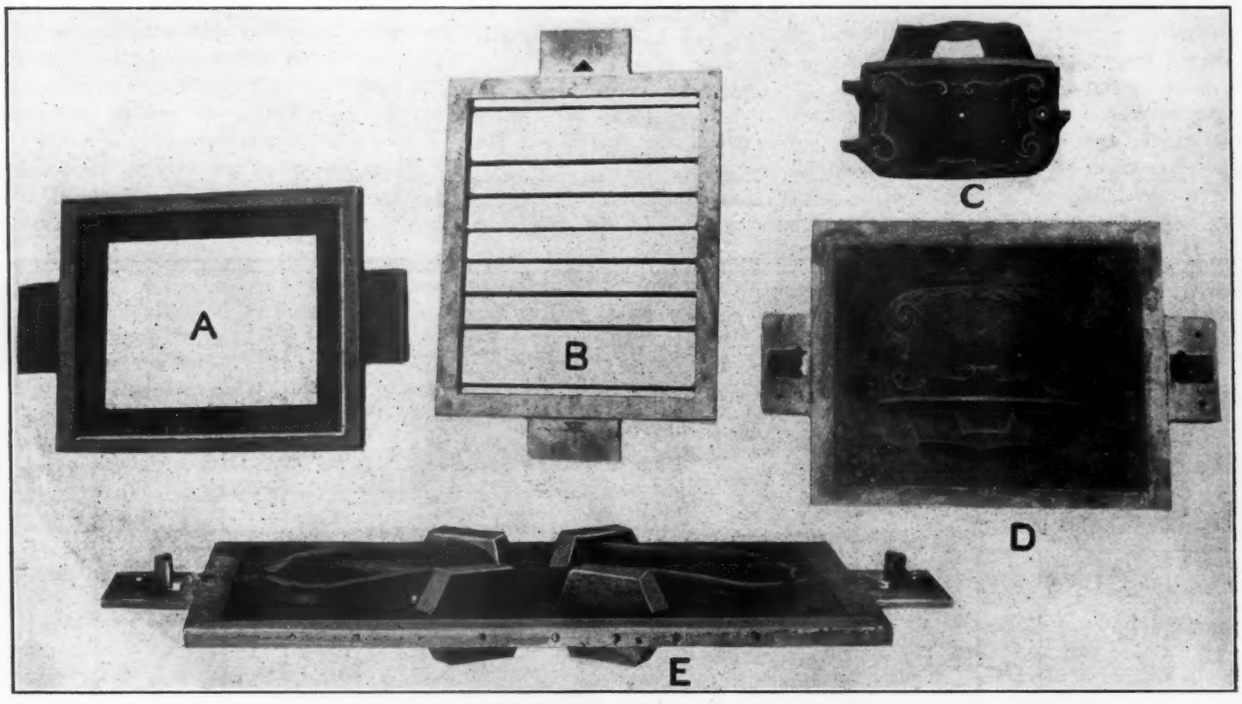


FIG. 4—WOOD PATTERN FOR FRAMES, REINFORCED ALUMINUM FRAME AND COMPOSITION MATCH-PLATES

The New York Graphite Co. will erect a plant for refining graphite at Harcourt, Ont., Can.

Continuous Melting in a Small Cupola

By W. J. Keep

Question.—What weight charges do you recommend for a 22-inch cupola operating continuously for eight hours?

Answer.—The bed should reach and should be maintained at a point 15 inches above the tuyeres. Two hundred pounds of iron and 20 pounds of coke would be the charge for a run of two hours and three tons per hour would be fast melting in a 22-inch furnace. The pigs should be broken into short lengths and the scrap should be small while care should be exercised to prevent the charging of dirt or dust. It then becomes a problem of the rapidity with which coke can be burned in such a small area and how thoroughly the cupola can be slagged-off. Frequently the slag will harden around the sides of the furnace and will prevent the iron from settling and in this event, melting would stop. The limestone used should contain approximately 80 per cent of lime and the slag should flow off in a steady stream.

As it is customary in your practice to use nearly all stove plate scrap broken rather fine, care should be exercised to prevent the charging of ashes and rust that fall off the scrap while it is being broken, and enough silvery iron, high in phosphorus, should be charged to make the iron fluid. It is customary to use more coke than I have indicated to keep the cupola hot enough to prevent the chilling of the slag.

What Congress Thinks of the Aluminum Tariff

Report of the Discussion of the Proposed Reduced Duty on This White Metal in the House of Representatives

OFFERING an amendment to continue the present duty of 7 cents per pound on aluminum, Representative Austin, Republican, of, Tennessee, in the debate in congress, under the five-minute rule of the proposed Underwood bill, made a vigorous defense of the existing duty. Strong attacks were made by him on the proposed 25 per cent ad valorem duty, which is a reduction of practically 2½ cents per pound. His amendment, like every other one offered by the Republicans, was defeated.

Supporting the reduced duty, was Representative A. Mitchell Palmer, Democrat, of Pennsylvania, who had charge of the metal schedule, and his arguments were set forth with equally as much force as were those of Mr. Austin.

Foreign Competition

It was asserted by Mr. Austin that Georgia, Tennessee, Alabama and Arkansas are the only states in this country known to have deposits of bauxite, and he demanded to know if it would be to the best interests of America and those four states especially, to reduce the duty and permit French makers, with a surplus of 34,000,000 pounds annually, to enter into competition with manufacturers of aluminum made from southern bauxite. Pointing out that there are only two aluminum companies in the United States, the Aluminum Co. of America, and the Southern Aluminum Co., the latter a new company and having in course of erection its plant at Whitney, N. C., he said this country is producing 45,000,000 pounds of aluminum each year and is importing from France and other countries 12,500,000 annually. The provision in the Underwood bill, he declared, would increase importations in value from $1,857,000 to $2,500,000, and would deprive American wage earners of $385,800 annually. He arrived at this figure by computing the labor cost of producing aluminum at 60 per cent of the cost of production. The average wage per day in the aluminum industry abroad, he said, is 80 cents as compared with $2.50, in this country. Admitting that the Aluminum Co. of America is a monoply, Mr. Austin declared that there is also a trust in France and in other foreign countries.

"If there is a monopoly trust there, why should not the American congress prefer an American monopoly or American trust, which voluntarily reduced the price of aluminum from $80 per ton to 17 cents per pound, in preference to a foreign trust or foreign monopoly?" he asked.

He submitted an appeal from business organizations of Knoxville, Tenn., in the interest of the aluminum industry.

No Competition in Aluminum

Opening his argument with the statement that, if there is any rate in the entire bill which is absolutely justified by facts, Mr. Palmer said it is the rate proposed in the Underwood tariff. Constituents of Mr. Austin, he said with emphasis, do not care particularly about the tariff rate upon aluminum, but the Tennessee representative was said to have in mind the identical thing that the Aluminum Co. of America has in its mind—the fact that bauxite, the raw material of the Aluminum Co. of America, has been put on the free list. Not a particle of competition exists anywhere on earth in the aluminum business, Mr. Palmer said. The Aluminum Co. of America was assailed as a country-wide monopply in America, and it was added there is a trust abroad as well, of which the Aluminum Co. of America is the founder and biggest part.

General Manager Davis of the Aluminum Co. of America testified before the ways and means committee in January, Mr. Palmer said, that he went to London and wrote the agreement on behalf of his Canadian company, owned by the Aluminum Co. of America, which fixed the price and divided the market all over the world. Gigantic as it has become, the Aluminum Co. of America is not big enough, it was explained, to have secured sufficient water power necessary for the manufacture of aluminum, to entirely supply the American market. This was assigned as the only reason that a rate was left upon aluminum at all. The American company is compelled, Mr. Palmer said, to permit its foreign associates to send into this country something like $1,800,000 worth of aluminum annually. The American company was declared to own all the bauxite in this country, and the Frenchmen who are building the plant at Whitney, N. C., who were described as being "venturesome," could not compete with the American company unless bauxite was put on the free list, Mr. Palmer added.

The voluntary reduction by the American company was made, he said, because of the fear that it would "so incense the public mind that attention would be drawn to its unconscionable activities, and as a trust it would be wiped out of existence". Improvements, inventions and discoveries made in the manufacture and uses of aluminum were also ascribed as a cause of reduction in price. It was asserted that on an actual investment of something less than $2,000,000, the Aluminum Co. of America is today declaring dividends upon its stock, amounting to nearly 200 per cent on all the money originally invested, and with the present comparatively low price of aluminum it is making enormous profits.

Aluminum Pattern Plate Alloy

Question.—We are making aluminum pattern plates from a mixture consisting of four parts of aluminum and one part zinc. The plates are ⅜ inch thick, while the patterns vary in thickness from ½ to ¾ inch. Unless we use chills in the drag, the metal draws and when the drag is heavily chilled, the plates draw around the edges. Can you furnish us with an aluminum pattern plate mixture that will not shrink excessively?

Answer.—The zinc in your mixture is the cause of the excessive shrinkage and we would suggest that the following alloy be substituted for the one you are using: Aluminum, 92 per cent, and copper, 8 per cent. This alloy should be made by the use of a hardener consisting of equal parts of copper and aluminum. The copper is melted first and the aluminum is added gradually so as not to chill the molten copper. A better method is to melt the aluminum and to pour it into the copper, stirring it constantly. After the alloy is made it is poured into ingots.

Charles F. L'Hommedieu & Sons Co., Chicago, will build a new plant to contain 14,000 square feet of floor space.

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Trade Outlook

BASED on the quotations prevailing in the pig iron market and the general inactivity of trade in this commodity, the foundry industry must have suffered a sad reversal of conditions. On the contrary, the demand for castings continues unabated and in nearly all sections of the country the shops are busily engaged. In view of the comparatively high prices prevailing for coke, it is evident that the stagnation of the iron market must be attributed to temporary over-production, although some furnaces continue to make shipments in excess of their daily melt. Thus far a comparatively small tonnage of foundry iron has been purchased for the last half of the year and producers are resisting every effort to scale down existing quotations. The scarcity of skilled labor is the best barometer by which foundry trade conditions can be measured, and not since 1905 have the molders been as steadily engaged as at present. Consumers of malleable and steel castings continue to experience difficulty in obtaining early shipments and the non-ferrous shops report that if aluminum were obtainable in the quantities required, their melt would surpass all records. In the south, iron producers will not quote below $11.50 for No. 2, for either prompt or future delivery and an offer of $11 on a large tonnage has been refused repeatedly. At Pittsburgh, $15.25 is asked, and in the east slightly better prices prevail, No. 2 being quoted at $17, Philadelphia. Malleable Bessemer is held at $16.50 and Lake Superior charcoal, $18, Chicago.

The production of wire nails in 1912 amounted to 14,659,700 kegs of 100 pounds each, as compared with 13,437,778 kegs in 1911, an increase of 1,221,922 kegs, or nearly 9.1 per cent. Steel wire nails only are included in these figures.

Foundry Iron Production

ACCORDING to statistics compiled by the American Iron and Steel Institute the production of foundry iron in 1912 aggregated 4,969,856 tons, against 4,397,729 tons in 1911, an increase of 572,127 tons. To this should be added the output of malleable Bessemer, which was 825,643 tons in 1912, making a grand total of 5,795,499 tons. The previous year the malleable Bessemer production was only 612,533 tons, 1912 having shown an increase of 213,110 tons. White and mottled iron, direct castings made at blast furnaces, etc., aggregated 54,613 tons in 1912, as compared with 45,192 tons in 1911, an increase of 9,421 tons. It is to be regretted that no figures are available showing the castings production, although this can be fairly well estimated by assuming a scrap content of 40 per cent in foundry mixtures. On this basis the gray iron and malleable casting output in 1912 is estimated at approximately 8,000,000 tons, and if the steel casting production is added to these figures the total will closely crowd 9,000,000. In addition, the non-ferrous metal tonnage annually cast amounts to a liberal total and the figures herewith presented indicate the constantly growing influence of the foundry trade and the position it occupies in the front rank of the country's lead-

ing industries. Pennsylvania was the largest producer of foundry iron in 1912, having succeeded Alabama, which was in the lead in 1911. In 1912, Pennsylvania made over 23 per cent of the total output of foundry pig iron and Alabama, over 21 per cent. The previous year, Alabama's share of the total was 27.7 per cent against 17.2 per cent for Pennsylvania. The country's production of all grades of pig iron in 1912 aggregated 29,726,937 tons, as compared with 23,649,547 tons in 1911, an increase of 6,091,280 tons. On a percentage basis, the production of the various grades last year was as follows: Bessemer and low-phosphorus, 39.2 per cent; foundry, ferro-silicon and high silicon, 17 per cent; basic, 38.4 per cent; forge, 1.5 per cent; spiegeleisen and ferro-manganese, 0.7 per cent, and malleable Bessemer, 2.7 per cent. The total production of pig iron in Canada in 1912 was 912,878 tons, against 824,368 tons in 1911. Of the 1912 output, foundry iron, ferro-silicon and high silicon grades constituted 194,208 tons, as compared with 190,324 tons the previous year. In the 10 years from 1903 to 1912, there was but one year, 1908, when the production in the Dominion did not show an increase over the output of the preceding year. It was not until 1902 that Canada began to develop its steel industry and since that year both its pig iron and steel output has had an almost uniformly steady and rapid growth.

Not since 1905 has so large a percentage of the members of the International Molders' Union been employed as at the present time. Recent reports show that 97 per cent of those affiliated with this organization are steadily engaged.

Brick-Bat for the Editor

ON PAGE 210 of the May, 1913, issue of THE FOUNDRY was published an article, entitled "It's a Great Game", which contained a few extracts from a prospectus of a projected foundry supply and equipment manufacturing company. Judged by the number of different lines in which this company intended to engage, the corporation was to have been of the blanket type and as such it merited the attention it received in our last number. The president of this company, however, is of a different mind, although he admits that the New York broker's "methods are not correct, and has ordered him to refrain from sending out any more of the prospectus'." The president's communication, in full, follows:

> Enclosed find express money order for one ($1) dollar, to be applied as follows: 60 cents to pay for the four numbers of the paper that have been received, viz.: February, March, April and May; the remainder, 40 cents, to pay for the ink that was used printing the unmanly, unwarranted, sarcastic and wholly uncalled for editorial in the May number of THE FOUNDRY under the caption "It's a Great Game".
>
> The extracts printed are from a prospectus issued by the board of directors of the ———— ———— Company, an incorporation legally organized and which will do a legitimate business in the manufacturing line, as well as the production of molding sand, the selling of foundry supplies and the making of brass, bronze and other metal articles, all of which is legitimate.
>
> Some of the officers of the company own and hold the patents on several articles that they will manufacture and place on the market, and for which it is believed a ready market will be found.
>
> None of the men connected with the company have the "Golden Tongue" and are not trying to sell securities in a "Bottomless Oil Well," nor in a "Shot Gold Mine," but a purely industrial proposition that will stand any investigation that may be made.
>
> Lacking the capital to engage in the business, we took the same method that has been employed by thousands of the most successful enterprises in operation today, and sought the assistance of those who have the money to invest, and placed the sale of our stock in the hands of a broker in New York City, who thought that he could obtain the amount that we desired and found was necessary to make it a success.
>
> We are sorry that he has so far been unable to live up to his claims and think that his methods are not correct, and have ordered him to refrain from sending out any more of the prospectus.
>
> There is nothing so despicable as an editor of a paper or magazine who will traduce honest men who aspire to engage in business and hide behind the pages of his organ, for he knows that those whom he attacks have no opportunity to reply except by paying at "so much per".
>
> We will make a success in spite of your "knocking," but we will rescind the action of our board, in which it was agreed to give your paper a contract for advertising as soon as we began business.
>
> We wish to thank you for your decision not to become a stockholder, as we have had a past acquaintance with your methods.
>
> Discontinue my subscription from the May number.

In making the 29,726,937 gross tons of pig iron produced in 1912, there were consumed 35,721,127 net tons of coke, 47,022 net tons of anthracite coal and 35,436,017 bushels of charcoal. The average consumption of coke per ton of pig iron made in that year was 2,436.5 pounds; anthracite coal and coke mixed, 565.2 pounds of the former and 2,341.6 pounds of the latter; of anthracite coal alone, 2,954.7 pounds, and of charcoal, 102.1 bushels per ton. The average consumption of iron ore in 1912 per ton of pig iron made was 1.872 tons, as compared with 1.859 tons in 1911. The average consumption of limestone per ton of all kinds of pig iron made was 1,137.2 pounds in 1912, against 1,153.6 pounds in 1911.

Substitute for Fuel Oil

DUE TO the scarcity and high price of fuel oil, the crucible steel castings makers in the Milwaukee and Chicago districts have been driven to all kinds of expedients to discover a suitable fuel. Some foundries have been experimenting with distillate and very satisfactory results have been obtained. Distillate is a petroleum product which is driven off following gasoline in the refining process. It is a cross between kerosene and gasoline and sells at present at about 5½ cents a gallon in Milwaukee. It is burned in the furnaces like fuel oil, except that owing to its volatile nature, only one burner pan instead of three or four are used. The burners are not changed, the unused pans in the standard Milwaukee type crucible furnace being merely bricked-up. The consumption of distillate is said to be only about one-half of that of fuel oil and this, to a large extent, balances its relatively high price. Distillate is cleaner to handle than fuel oil, burns with less carbon deposit, and ignites more readily.

Equipment for the Foundry and Pattern Shop

Piston Molding Machines — Combined Jolter and Squeezer — Dry Grinder — Jar-Ramming Stripping Machine — Molten Metal Pyrometer

THE automobile industry has created a demand for labor-saving foundry equipment of many kinds including special machines for molding pistons. When it is considered that every motor-car engine contains from four to six pistons, the magnitude of the problem even to the factory turning out from 50 to 100 cars a day becomes apparent, and the foundryman is concerned not only with the question of volume, but also with exacting quality specifications. In short, the problem is one that lends itself readily to a satisfactory solution by machine molding and a number of prominent manufacturers have designed equipment specially to meet the requirements of piston production.

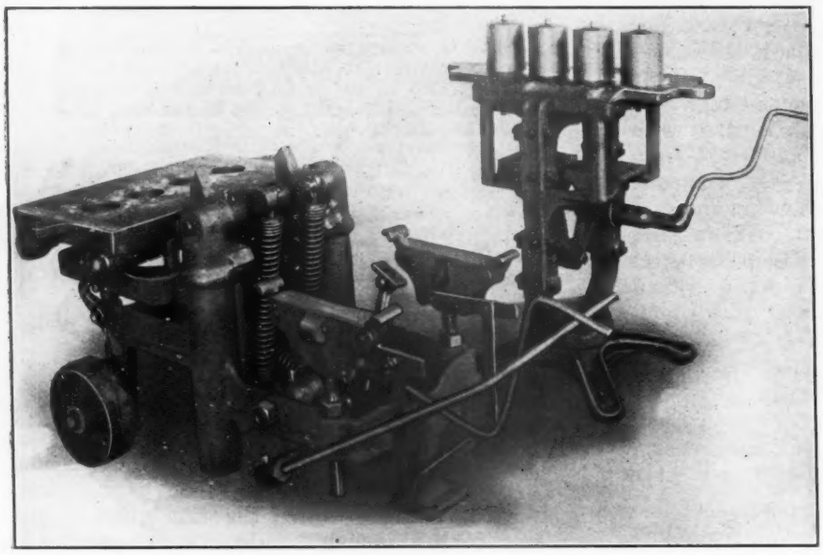


FIG. 1—INTERNATIONAL PISTON MACHINES READY TO RECEIVE FLASKS

One of the latest machines of this character is that recently placed on the market by the International Molding Machine Co., Chicago. Two machines comprise the equipment, one being a plain stripping plate design for molding the copes and the other a turn-over draw machine for the drags. The green sand cores stand up from the drag instead of hanging down from the cope, thus making a mold that will undergo rough handling without injury.

In Fig. 1 the two machines are shown in position ready for the flasks. The plate in which the drag patterns are imbedded is split through the middle, making two divergently sliding sections. When the mold is being made these sections fit close together, but after the flask has been rammed and turned over ready for the patterns to be drawn, the lever with which each section is provided is revolved. This separates the sections, as shown in Fig. 2, splitting the patterns in half and drawing them out sideways from the mold. Pin bosses, also grooves or ribs, if there are any, are all drawn out at one operation. The turn-over frame with its sectional pattern plate is then raised away from the mold by pressing the foot lever of the machine and the flask is set off onto the floor. The four pockets of sand are standing up instead of hanging down unsupported as they would be if this part of the pattern were made in the cope, and thus most of the danger of breaking the green sand cores when setting the mold down is eliminated.

The patterns on the cope machine, after the mold has been rammed, are drawn down through the stripping plate their entire depth and therefore require no taper.

The ramming on these machines is done entirely by hand, the nature and shape of the patterns being such that a certain amount of hand tucking is considered necessary, and it takes a very short time to finish up the mold and strike it off. The turn-over machine is fitted with a vibrator which operates automatically when the patterns are ready to be drawn and likewise ceases to operate as soon as the patterns are entirely freed from the mold.

The flasks used on the particular equipment shown are made of steel, 8 x 20 inches and 10 inches deep, and are provided with long guide pins. The saving in the labor of making cores is said to be $10 per day for each set of machines.

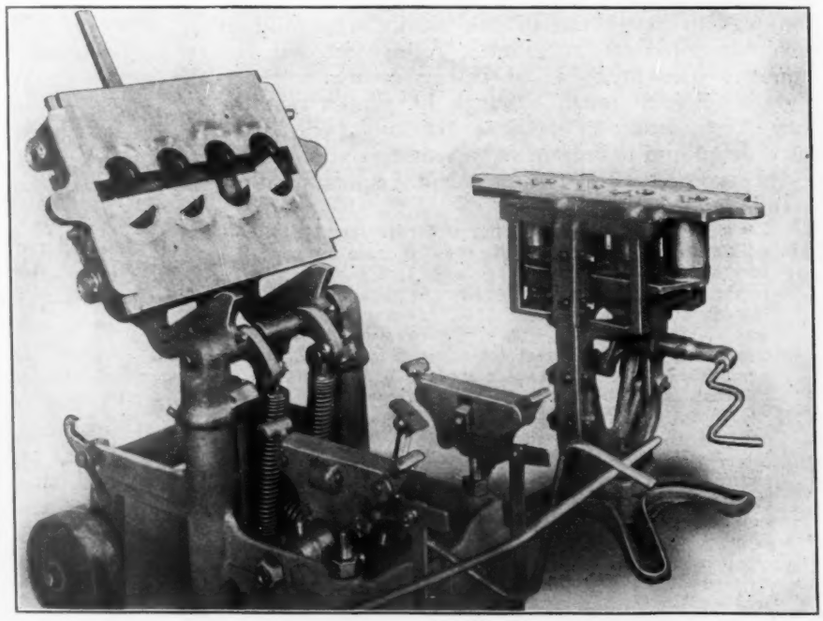
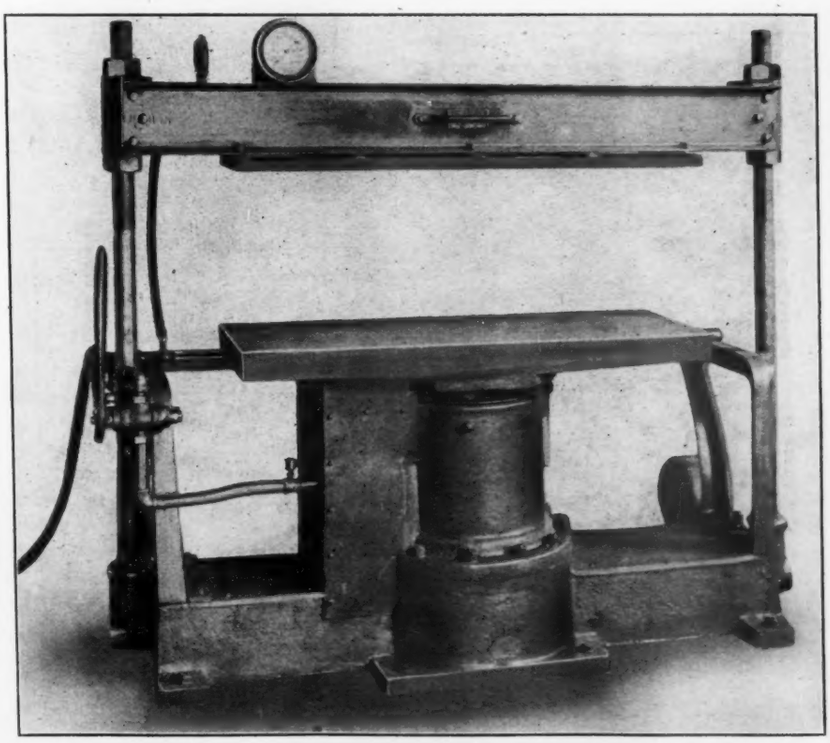


FIG. 2—COPE MACHINE WITH PATTERNS DRAWN THROUGH STRIPPING PLATE AND DRAG PARTLY ROLLED OVER

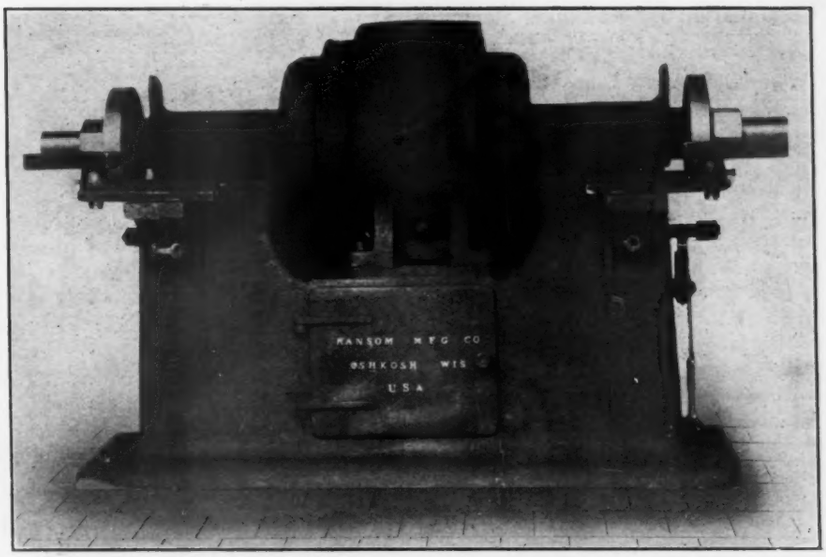
While this equipment is designed primarily for molding pistons, the special features of its construction are not such as to interfere with its being used for other work. The turn-over draw machine is equipped with an adjustable flask clamping rod which revolves on the horizontal steel center shaft. The flask rests, which can be raised or lowered according to the size of the work to be molded, adjust themselves automatically to the plane of the bottom boards.

Large Combined Jolter and Squeezer

A combined jolter and squeezer of unusually large size recently has been designed and built by the Arcade Mfg. Co., Freeport, Ill. As indicated by the accompanying illustration, the machine has the same general design as the smaller sizes that have been built previously. The table, however, is 24 inches wide and 44 inches long, while the distance between uprights is five feet. The table stands 30 inches from the floor and the extreme distance between the head and the table is 20 inches. A 13-inch cylinder with an approximate air consumption of 1½ cubic feet per mold is used to jolt the table. The machine has an extreme width of 80 inches and weighs 2,500 pounds. It may be used as a simple squeezer, a plain jolting machine or to combine the jolting and squeezing operations. When the head is tilted back, the valve regulating the jolting is opened, and by operating the lever at the left of the machine, the jolting proceeds. After the mold has been jolted and struck off and the squeezing board adjusted, the head is swung forward to the position shown in the illustration. This automatically closes the valve controlling the jolting mechanism. After the squeezing is accomplished, the head is pushed back and the pneumatic vibrator is set in motion by the knee pad.



COMBINED JOLTING AND SQUEEZING MOLDING MACHINE



MOTOR-DRIVEN DRY GRINDER BUILT BY THE RANSOM MFG. CO.

Motor-Driven Grinder

A motor-driven dry grinder, provided with a 3-inch spindle, built by the Ransom Mfg. Co., Oshkosh, Wis., is shown in the accompanying illustration. It will be noted that the armature shaft is extended to receive emery wheels on both ends. The machine can be furnished either with direct or alternating current motors and when equipped with a direct current drive a speed controller is attached which eliminates the possibility of operating the emery wheels at too high speeds. Steel guards with exhaust pipe connections will be furnished if desired. The total length of the spindle is 80 inches and the bearings, 3¼ x 15 inches. The motor generally furnished is of 10-horsepower capacity, although 15-horsepower can be provided. The machine is designed for operating two 24 x 4-inch emery wheels for heavy steel casting work, but wheels of larger diameter can be attached. The motor is entirely enclosed and the frame of the machine is of the box type.

"Graphite for the Boiler" is the title of a 16-page booklet issued by the Joseph Dixon Crucible Co., Jersey City, N. J. The use of flake graphite to remove scale that forms in boiler tubes is discussed and the method of feeding the graphite into the pump is described. This graphite forms a thin film over the boiler lining, protecting it from the action of acids in the water and associates itself with the sediment, thus preventing the formation of hard scale. As a result, the residue precipitated by the evaporation of the water is in such a soft condition that it can be easily ejected by the process of blowing off.

Combination Jar-Ramming Stripping Machine

To facilitate the production of small, but deep molds on jar-ramming machines, the Herman Pneumatic Machine Co., Zelienople, Pa., has designed a combination jar-ramming, stripping machine, as shown in the accompanying illustrations. The flask in molding position on the table of the machine, after having been jar-rammed, is illustrated in Fig. 1. In Fig. 2, the flask has been stripped off the pattern, which is mounted on a pattern plate, the latter being attached to the machine table. The pattern plate surrounds and rests on raised strips on the pattern plate. In Fig. 3, the mold has been removed from the machine and the stripping plate has been

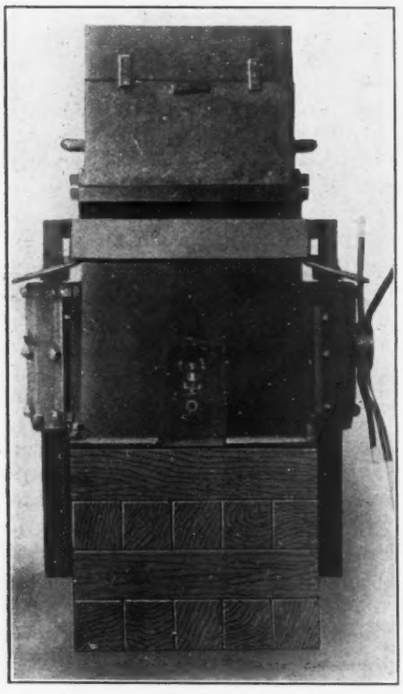


FIG. 1 — FLASK MOUNTED ON JAR-RAMMING, STRIPPING MOLDING MACHINE

lowered over the pattern in position for making another mold. Fig. 4 is a side view of the machine and shows the ribbing of the stripping plate, which conforms to the ribs of the pattern plate. The pawl used for locking the stripping mechanism at any desired height also is illustrated.

The machine consists of a cast iron base provided with equally-distributed, resilient jarring surfaces, while the table plate and plunger are steel, cast integral and provided with cast iron packing rings. The oiling system for the plunger and cylinder is inside of the plunger, the oil reservoir having sufficient capacity to provide the lubricant for the cylinder and plunger for a considerable

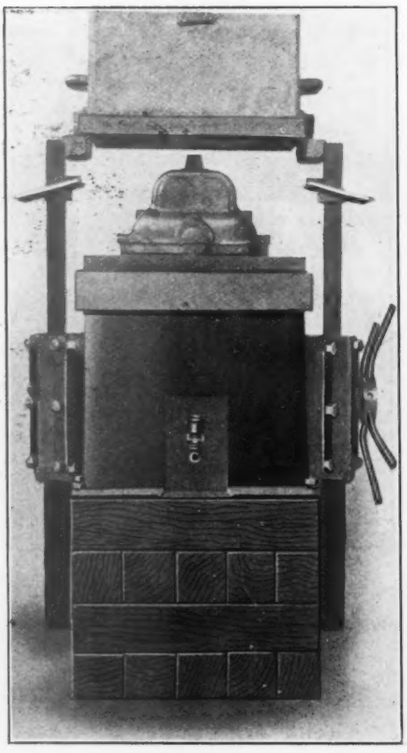


FIG. 2—MOLD STRIPPED FROM THE PAITERN

period. The control valve is of the Herman, automatic, sand-proof type, the same as is applied to all of the machines built by this company. The stripping mechanism consists of two steel racks, one on either side of the machine which mesh with two steel gears on either end of a shaft extending

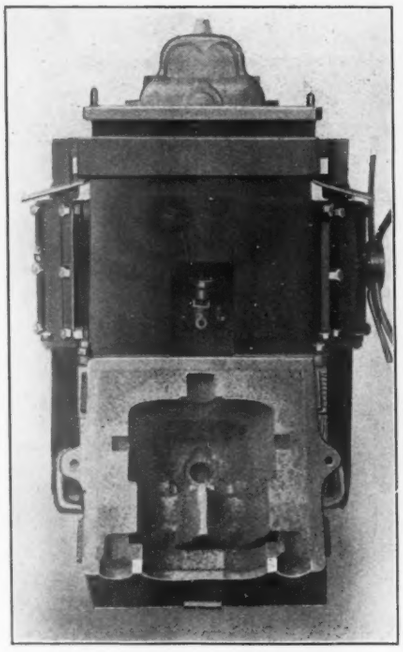


FIG. 3 — MOLD LIFTED OFF AND STRIPPING PLATE IN POSITION FOR MAKING ANOTHER MOLD

through the machine. Four levers are attached to a hub at one end of the shaft, as shown in Fig. 4, the ratio between the levers and the gears being 6 to 1, which permits the stripping of a heavy flask with little exertion on the part of the operator. Since the gears are attached to the shaft the racks are moved simultaneously, always insuring a perfect lift and the uniform stripping of the mold from the pattern. The shaft operates in four sand-proof bearings and the racks have long, adjustable, babbitted bearings. All operating parts are well-protected from the sand. The machine is bolted to a timber and concrete foundation. The table plate of the jar-ramming, stripping machine illustrated, is 16½ x 18 inches and the draw is 12 inches.

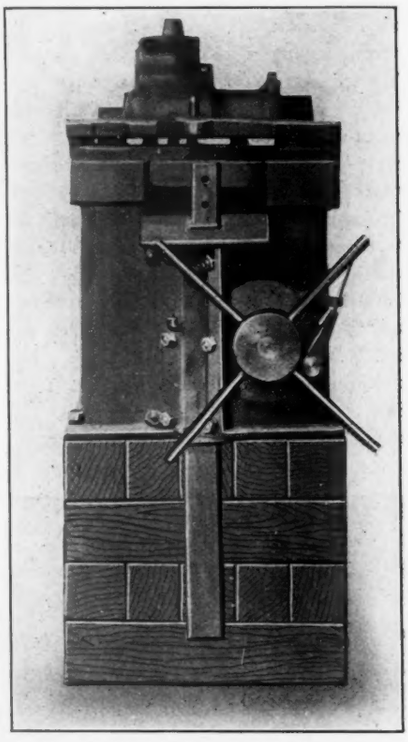


FIG. 4—SIDE VIEW OF THE MACHINE

Panama Canal Castings

The Damascus Bronze Co., Pittsburgh, is furnishing the bushings for the snubbing post mechanism to be used in connection with the gates for the locks of the Panama canal. This mechanism includes hydraulic cylinders and heavy chains. The vessels, when approaching the locks or when in the locks, will be permitted to bump against this chain, which will be stretched from side to side of the lock as the chain gives. The amount of this motion will be governed by the speed of the vessel and the action of the hydraulic cylinders, thus gradually reducing the momentum of the boat.

Arcade Piston Molding Machine

For molding gasoline engine pistons, the Arcade Mfg. Co., Freeport, Ill., has recently designed special pattern equipment which may be fitted to its standard type molding machine without altering any of the essential features of the latter. The attachments, which include a split drag pattern and a cope stripping plate, were developed primarily to meet the requirements of the Ford Motor Co., Detroit. The Ford plant is operating this year with an output of 800 cars daily, requiring 3,200 pistons. In addition, a large number of extra pistons are manufactured and shipped to branch houses carrying stocks of spare parts, together with quantities of special oversize pistons that are used to replace standard pistons in cylinders that have become worn by use. In other words, the Ford Co. is casting about 300 tons of pistons per month, this being equal to the total output of many foundries of respectable size. When made by hand on plain stripping plate machines, using dry sand cores, and allowing an output of 200 pistons per man, a gang of from 30 to 35 men was required, including core room labor. With the Arcade machine four pistons are made in a flask and a daily output of 150 flasks per man is expected. The core room work will be eliminated and the labor in the piston department reduced to one-fourth or one-fifth the amount necessary when using dry sand cores.

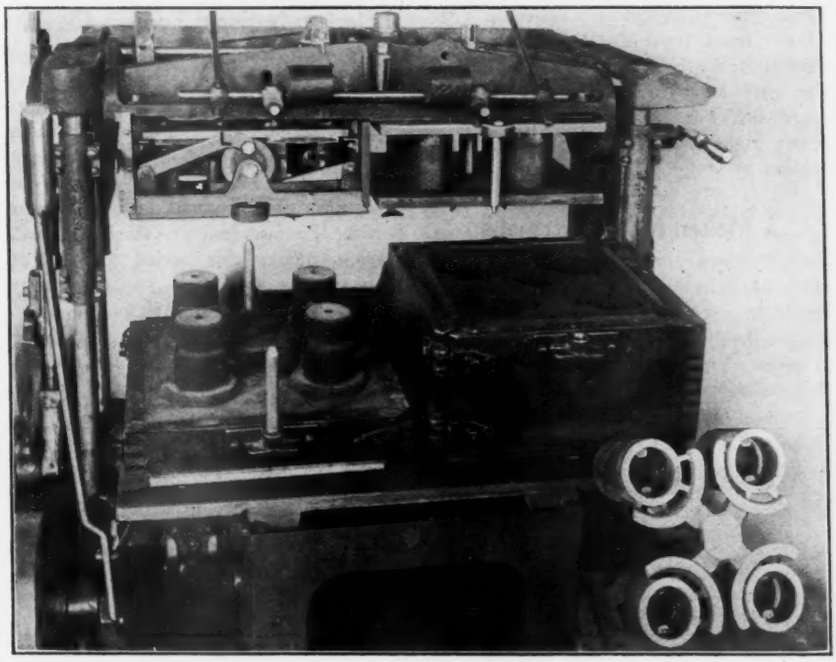


FIG. 2—PISTON MOLDING MACHINE WITH PATTERN DRAWN

The pattern plates are mounted on the revolving table of the machine. Fig. 1 shows the patterns in position ready to receive the cope and drag flasks. The drag pattern, at the left, contains split cup sections which are controlled by the linkwork, *L*. When the ramming operation is completed, the split cups separate, thus releasing the sand contained in the green sand cores. The cope pattern is simply a plain stripping plate which permits the mold to be made without draft.

In operating the machine, the flasks are placed on the pattern plates when they occupy the position shown in Fig. 1, the sand is thrown in, the surplus scraped off and the cope and bottom boards are clamped in place. The table is next rolled over, the mold pressed and the patterns drawn in the customary manner. Drag and cope halves of the mold are shown in Fig. 2. Of course, before the pattern plates are lifted, the lever controlling the linkwork connected to the split cup patterns is shifted, releasing the cores. The wrist pin bosses and reinforcing rings are all made in the core. When the patterns are drawn, the drag rests right side up on the platen of the machine with the green sand cores extending upward. All that is necessary to complete the mold is to place the cope in position over the drag and set the flask onto the floor. The long lever at the left of the machine is used in drawing the patterns and the clamps holding the cope and bottom boards are automatically released. The machine is also equipped with a pneumatic vibrator and automatic trip for vibrating the pattern. Being on wheels, the machine may be moved along the pile of sand as the operator makes up his floor, thus reducing the amount of walking to a minimum.

The metal is poured through a single central runner which connects with a

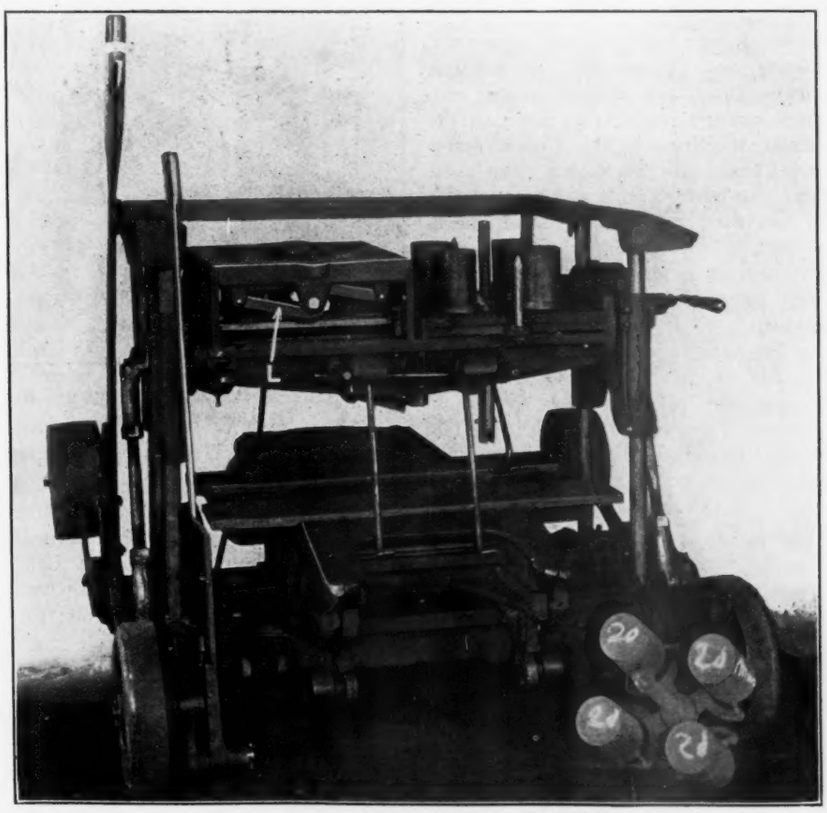
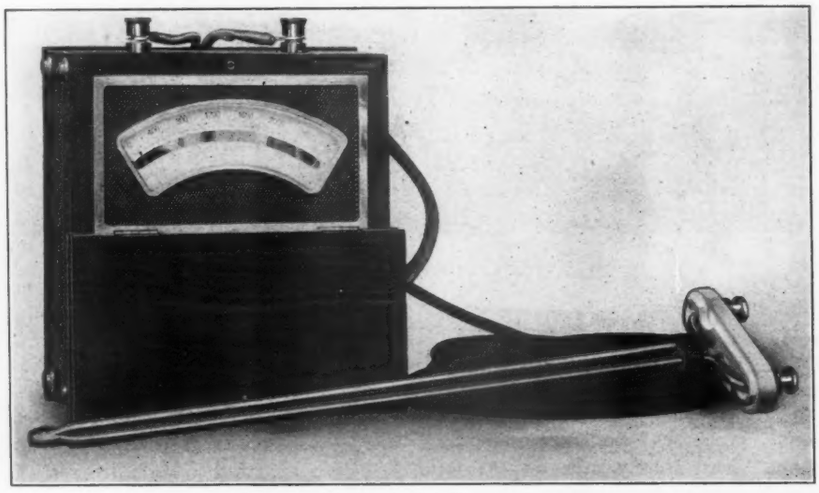


FIG. 1—ARCADE PISTON MOLDING MACHINE

cross gate in the drag. The iron rises in the mold from the bottom, insuring sound, dense castings. The details of the gate and runner are clearly indicated by the castings shown in the lower right hand corner of each illustration.

A Molten Metal Pyrometer

The Brown Instrument Co., Philadelphia, has conducted a series of experiments to develop a thermo-couple which will withstand, for a reasonable length of time, the action of molten metal, such as copper, brass, aluminum, bronze,



BROWN PYROMETER FOR MEASURING THE TEMPERATURE OF MOLTEN COPPER, BRASS, ALUMINUM, BRONZE, ETC.

etc. As a result, a thermo-couple has been produced which consists of nickel alloy rods, ¼ inch in diameter, and which are inserted directly into the metal. The life of the thermo-couple, owing to its size, is greatly increased as compared with thermo-copules ⅛ inch in diameter previously used. In conjunction with this thermo-couple a high resistance portable indicating instrument is employed, which is not affected by changes in the length of the wire connecting the thermo-couple and the instrument, and which is particularly adapted for foundry use. The complete outfit is shown in the accompanying illustration. To measure the temperature the thermo-couple is inserted directly into the molten metal before pouring. The use of pyrometers in brass foundries is particularly advantageous, as it aids in duplicating results after the proper pouring temperature once has been ascertained.

Iron, when chemically combined in brass or bronze, hardens the alloy. When not chemically combined, it separates out in small hard particles, which cause considerable difficulty in subsequent machining operations.

Peterson-National London Exhibit

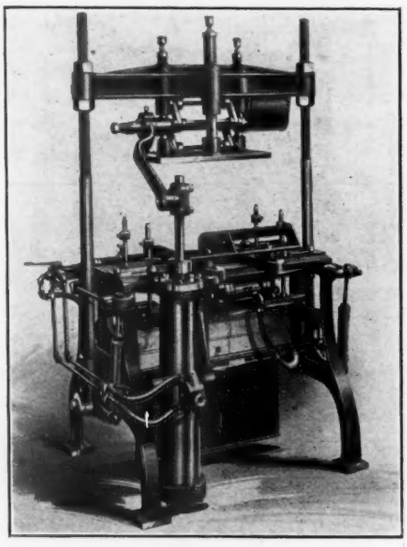
The Peterson-National Co., Chicago, manufacturer of core oil, dry core compound and parting, will have a large exhibit at the first Foundry Trades Convention to be held in Royal Agricultural Hall, London, Eng., from June 14 to 26. The annual meeting of the British Foundrymen's Association will be held during this period and all of its members will have an opportunity to inspect the exhibit of foundry supplies and equipment.

The Peterson-National Co.'s exhibit will consist of its various products, including core oil, dry core compound, parting and "Coretreen;" in addition, sample cores and castings made with the company's products by some of the largest foundries in the United States and Canada will be shown. The company also will display different grades of core sand used in the United States, as well as sand used for making cores and castings produced in English foundries by the use of Peterson-National products. T. J. Peterson, president of the Peterson-National Co., will sail for England on June 7 and G. W. Doty, demonstrator, sailed on May 29. Both representatives will be in charge of the exhibit throughout the convention. The establishment of a permanent London office is contemplated by the Peterson-National Co.

Berkshire Air Squeezer

To facilitate the ramming of molds on the squeezer type of molding machine built by the Berkshire Mfg. Co., Cleveland, a compressed air cylinder has been attached to the back of one frame, the piston being connected by an arm to the toggle mechanism which actuates the presser head. As shown in the accompanying illustration, the cylinder is mounted on trunnions and oscillates with the head. The operation of the piston is controlled by a valve lever and upon the completion of the squeezing operation it automatically releases the head, permitting it to return to its back position. If desired, the lever can be attached to the toggle shaft and the squeezing operation can be performed by hand. However, by the employment of the air cylinder the output can be increased materially and the operator is in better physical condition to pour-off his floor than when the ramming is effected by the hand lever.

The Berkshire Mfg. Co. reports the following recent sales of various types of molding machines: One automatic for F. Y. T. La Union, Buenos Aires, Brazil; squeezers and patterns for the board of public works, Melbourne, Australia; squeezers and patterns for the United States navy yard, Puget Sound, Wash.; orders for the installation of additional machines in the foundry of the Ford Motor Co., Detroit; McConway & Torley Co., Pittsburgh; General Malleable Co., Warren, O.; Imperial Brass Mfg. Co., Chicago; R. J. Schwab & Sons Co., Milwaukee; Reed Mfg. Co.,



BERKSHIRE SQUEEZER OPERATED BY COMPRESSED AIR

Kalamazoo, Mich.; Swedish Crucible Steel Co., Hamtramck, Mich.; Buick Motor Co., Flint, Mich.; Dominion Steel Castings Co., Montreal; Peterborough Lock Mfg. Co., Peterborough, Can.; National Hardware Co., Orillia, Ont., Can.; Abate Brass Works, Detroit; Adriance, Platt Co., Poughkeepsie, N. Y., and Steel & Radiation, Ltd., Toronto.

The Canadian Hanson & Van Winkle Co. will erect a large addition to its Toronto, Ont., plant, consisting of a building, 50 x 225 feet, four stories high.

THE MEN IN THE FOUNDRY TRADE

Where They Are and What They Are Doing

WALTER L. CHATFIELD has been appointed foreman of the foundry operated by the Buffalo Pitts Co., Buffalo.

VICTOR C. LASSEN, formerly of the Vanadium Metals Co., Groton, Conn., recently returned from a trip to Russia.

C. W. SNYDER has been appointed foreman of the William J. Oliver Mfg. Co.'s foundry, Knoxville, Tenn.

FRANCIS FENNELL has been appointed foreman of the foundry operated by the William Adams Co., Philadelphia.

BEN DREWS has been appointed assistant foreman of the West Allis, Wis., foundry of the Allis-Chalmers Co., Milwaukee.

H. W. CRANZ, formerly of Akron, O., has been appointed foreman of the foundry operated by F. E. Myers & Bros., Ashland, O.

JOHN F. FLECKENSTEIN has been placed in charge of the plating and polishing departments of the Lisenby Co., Fresno, Cal.

JOHN BELKA, formerly of St. Paul, on May 1 assumed charge of the plant of the St. Cloud Iron Works, St. Cloud, Minn.

C. WADSWORTH has established a manufacturers' agency at 961 Woodward avenue, Detroit, and would like to correspond with manufacturers desiring representation in the state of Michigan.

J. W. PATTERSON, formerly of New Castle, Pa., has been appointed superintendent of the new plant which is to be erected by the Dominion Bronze Mfg. Co. at Preston, Ont.

CLYDE BUMBAUGH, formerly affiliated with the American Steel Foundries, Alliance, O., is now connected with the steel foundry of the National Brake & Electric Co., Milwaukee.

HARRY BECKER has resigned as foreman of the foundry operated by the American Scale Co., Independence, Mo., and is now in charge of the gray iron shop of the Smith & Sons Mfg. Co., Kansas City, Mo.

H. T. GOLDSTEIN has resigned as superintendent of the foundry operated by Clure & Atkinson, Rochester, N. Y., to accept the superintendency of the aluminum foundry operated by the Buick Motor Co., Flint, Mich.

PAUL KLUMB, secretary of the Globe Foundry & Machine Co., Sheboygan, Wis., who has been engaged in foundry work for 40 years, has organized a company to engage in the manufacture of stationary and portable gasoline engines.

JAMES J. WALWORTH, formerly superintendent of the Everett Foundry Co., West Everett, Mass., has entered the employ of the Malleable Iron Fittings Co., Branford, Conn., manufacturer of malleable iron and steel castings.

T. N. JOHNSON, formerly associated with the United States Cast Iron Pipe & Foundry Co., has been appointed successor to E. A. Kebler, in charge of the Chicago office of the Massillon Iron & Steel Co., Rookery building.

JOHN F. STEEVES, formerly of the Beaver Dam Malleable Co., Beaver Dam, Wis., has been appointed superintendent of the foundry operated by the T. H. Symington Co., Rochester, N. Y.

Death of David Reid

David Reid, formerly president of the Associated Foundry Foremen and an active member for many years of the American Foundrymen's Association, died at Webster, Mass., on May 1, age 42 years. His foundry experience covered a period of a quarter of a century, beginning at the age of 17 years, when he served his apprenticeship with the Holyoke Machine Co., Worcester, Mass. Later he was employed in a shop at Pawtucket, R. I., but subsequently he went to Scotland on account of ill health. Returning in 1898, he entered the employ of the Builders Iron Foundry, Providence, R. I., and in 1900, he became foreman of the Saco-Pettee plant, Biddeford, Me. While thus employed, he spent his week ends at Boston, taking a course at the Boston Testing Laboratories. In 1904, he was appointed foreman of the H. & B. American Machine Co., Pawtucket, R. I., and later he was placed in charge of the Rarig Engineering Co., Columbus. In 1907, he was appointed superintendent of the new foundry built by the Canadian Westinghouse Electric & Mfg. Co., at Hamilton, Ont., leaving this position in 1909 to organize the Reid Foundry & Machine Co., which operated a plant at Ingersoll, Ont. The shop subsequently was destroyed by fire and broken in health, he returned to Webster, Mass., where he assumed charge of the foundry operated by J. B. Prescott & Son. At the time of his death he was general manager of the Prescott Selling Co., with offices in New York City.

Notes on Cores, Core Boxes and Prints

By J A Shelly

ONE OF THE most important branches of the founder's art is the production of cores and it is advisable for the apprentice patternmaker to study carefully the methods of the coremaker and the action of the materials of which cores are made. By doing this and carefully noting the changes that take place in the core, from the time it is turned out of the box until it is delivered to the molder, he can save the latter a large amount of unnecessary work and worry. The most common source of trouble is caused by the cores swelling in the drying process and the failure of the patternmaker to make due allowance for this, with the result that the cores must be filed to fit the impression made by the print. Swelling is attributed to the different mixtures in common use and as these vary in different localities, no fixed rule can be established to counteract this increase in size, but by a careful study of shop conditions, the core boxes can be made to provide for this expansion.

The surface is the only part of the core thus affected and it is to counteract this surface swelling that the patternmaker, who takes pride in his work, must bend his efforts. A rule applied to round and half-round cores, in vogue in some shops, is to make the box to standard up to 8 inches in diameter, and the print to shrinkage rule, and to allow 1/16 inch per foot above that size. On a 20-inch core this would make a difference of ⅛ inch between core and print; this would seem to be about the proper allowance for swelling and blacking, but as previously stated, this is a

factor that is regulated entirely by local conditions. We will consider, for example, a hollow piston, divided inside into four, six or even more compartments, with ribs between each compartment and a round or elliptical hole through each rib. It is the customary practice to make a separate core for each compartment, the core box being made with half the dividing rib in each side, and it can be asserted safely that two-thirds of the cores so made will have to be filed where the cores touch to make the openings through the ribs. This is true of all circular work in which the cores are made in segments, and it is much better to make the cores a trifle short than too long, as the molder usually can *make-up* a shortage with comparative ease, whereas he experiences considerable difficulty in removing surplus stock. It is no small job to have to file ¼ inch of sand and core iron from the end of a core in order to get it into place.

Reverting again to pistons, it might not be out of order to state that the core prints for carrying the compartment cores should be tapered, preferably loose, and located on the cope side of the pattern. Hanging the cores in the cope dispenses with the use of chaplets and permits the core vents to be taken off through the top of the mold, with a better chance of obtaining a sound casting.

Round Prints

The patternmaker apprentice always is puzzled over the sizing of round prints. Whether they should be *to size* at top or bottom is a debatable question, but a good rule is to make them a trifle undersize at the top and the same amount oversize at the bottom. This brings them exactly to size midway their length and permits the core to enter easily and to tighten-up as it is pushed into place. Tapered or cope prints always should be *to size* on the bottom and some standard of taper angle should be maintained in every shop in order that there be some degree of interchangeability in the core boxes.

The proper lengths for prints is another problem that has never been solved satisfactorily, nor has an attempt been made to establish a standard. Up to 2 inches in diameter, a proportion that serves well in most cases is to have the diameter and length equal for straight prints, with the tapered or cope prints 25 per cent shorter. Where a long core runs entirely through a piece, however, and its sectional area is not great enough to provide sufficient base to maintain it in an upright position unsupported, the foregoing proportion for straight prints would not answer. It would be necessary to provide a longer print and if a cope print were not used, the print would have to be further increased in length.

Heavy cores with large base areas require only small prints when they are to stand in an upright position or are to be hung in the cope and there are many instances where a molder would prefer that a print be dispensed with entirely, as it affords him a better opportunity to regulate by measurements the thicknesses of metal required.

Prints for Cylindrical Work

When patterns are parted longitudinally, with prints on both ends to support the cores, as in some types of steam and pump cylinders, a good rule is to allow a 3-inch print for the first 12 inches of length and an additional inch for each 12 inches of increased length. This is found sufficient for most jobs in green sand and for dry sand work the prints safely may be made 20 per cent shorter.

Tail prints and cores also are worthy of some consideration. To set a core in place it frequently is necessary to use a tail print, and the usual plan is to carry the print to the joint, giving it plenty of taper on the sides. This is good practice, but it is a mistake to make the core in one piece, as the tail invariably draws either in or out and makes an unsightly spot on the side of the casting where the print was located. A much better plan is to stop-off the tail part of the print after the core is in place. This is easily done by making a piece to conform to the surface to which the print is fastened, but somewhat wider than the print and notched-out to fit over the core. This is used to prevent the sand from falling into the body of the mold while the tail is being filled-in, or stopped-off, as they say in the foundry.

Slag Tapping

By W. J. Keep

Question.—As it is our practice to draw the molten iron as fast as it is melted in the cupola, we would like to know whether it is more satisfactory to have a large tap hole containing a partition for a slag overflow or whether the slag should be tapped at the back of the cupola. Up to the present time we have used two German reservoir cupolas, but we are now installing a 45-inch cupola without a reservoir and hope to melt 22 tons of iron in 2½ hours. The coke we are using is clean, but sometimes it is broken rather small, while the limestone is not the best, although it is crushed.

Answer.—It is not probable that you will melt as fast as you expect in so small a cupola. I prefer to use a rear slag hole, about 4 or 5 inches below the tuyeres. The arrangement of the tuyeres in your new cupola is not satisfactory, as it does not provide a good location for the slag hole, and there is danger of the slag being chilled by the blast. If you should find this to be the case, close the section of the tuyeres directly over the slag hole. To make the slag fluid, a good grade of limestone should be used, but dolomite should not be employed.

The slag hole should be approximately 1 inch in diameter and it can be closed when the slag stops flowing. By a little care, the size of both the tap and slag holes can be regulated to give a continuous stream of metal. It is satisfactory to use a spout with partitions, but it cannot be taken care of readily. In case of accident it is well to be able to hold the iron in the cupola, which cannot be done with a partitioned spout. Receivers are quite satisfactory, but there are times when a simple spout is better.

In one of the sketches which you submitted a cross spout is shown which can be tilted in front of the regular tapping spout so that when one 700-pound ladle is filled the spout can be tilted and the iron run into another ladle at the other end. This saves stopping-up and re-tapping the cupola while the ladles are changed, but by using a hand ladle while shifting and by pouring the iron that is caught in this way into the larger ladle when in place, the use of the cross spout can be eliminated. A short, single spout insures hotter iron in the ladle and can be kept in better shape than a tilting spout.

With reference to the sand bottom, a pitch of about 1½ inches from back to front for a 45-inch cupola should prove satisfactory. The incline of the bottom only should be sufficient to drain the furnace clean when through melting. With a simple spout and tap hole it is advisable to keep a 6 or 8-inch head of iron in the cupola to prevent the slag from coming out with the iron and also to prevent the chilling action of pieces of iron which might fall through the melting zone into the hearth. This will not be noticed if there is a reservoir of iron on the bottom. This reservoir will not prevent drawing the iron as fast as it is melted and by keeping the tap hole the right size the stream will be continuous. Frequently, however, the tap hole will get too large and it must be stopped-up occasionally to prevent the escape of slag. To melt 10 tons per hour, the tap hole should be ⅝ inch in diameter to produce a continuous stream of metal.

The New York Buff Co., manufacturer of polishers', platers' and grinders' supplies, is now located in its new factory on Canal street, New York City.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Carlisle Frog & Switch Mfg. Co., Carlisle, Pa., is planning a foundry addition.

George Cole, Kansas City, Mo., has established a foundry at Pleasenton, Kas.

A. L. Leadbetter, Waterville, Me., will open a foundry on Front street.

The Portland Stove Foundry Co., Portland, Me., has erected a three-story addition to its plant.

The Spring City Foundry Co., Waukesha, Wis., has located a foundry in the old car barns on St. Paul avenue.

The Beloit Foundry Co., Beloit, Wis., has recently completed a steel and brick addition, 36 x 40 feet.

The Stedman Foundry & Machine Works, Aurora, Ind., increased its capital stock from $50,000 to $125,000.

The Wheeling Mold & Foundry Co., Wheeling, W. Va., is making extensive improvements to its plant.

The Dawson Foundry, Dawson, Pa., which is equipped to manufacture gray iron castings, will be dismantled.

The Gerline-Meyers Brass Foundry Co. has been incorporated with a capital of $20,000 to operate a brass foundry.

The American Tube Works, Boston, is erecting a one-story addition to its foundry, 67 x 76 feet.

The National Brass Co., Grand Rapids, Mich., will build a two-story plant, 72 x 126 feet.

The King Bronze & Aluminum Foundry Co., Cleveland, will erect a brass shop at 1730 East Thirty-seventh street.

The Pioneer Brass Works, Indianapolis, will erect an addition to its foundry and machine shop.

The Newell Brass Foundry, Central Falls, R. I., is building a new brass foundry and finishing shop.

The Tifton Foundry & Machine Co., Tifton, Ga., will build an addition to its plant. The capital stock will be increased from $25,000 to $50,000.

J. L. Fortener, Delphos, O., will operate a foundry in the Delphos washing machine factory which he recently purchased. R. F. Marsh will be associated with him.

The Western Foundry Co., San Francisco, has been incorporated with $50,000 capital, by J. E. Cope, John Hedley, and P. Hedley, all of San Francisco.

The firm name of the George E. Dow Pumping Engine Co., Alameda, Cal., has been changed to the Dow Pump & Diesel Engine Co.

The Illinois Foundry & Machine Co., Belleville, Ill., has been incorporated with $4,500 capital by Edward Ebner, A. Schoenberger, and Fred Ziehnert.

The Norman & Lewis Foundry Co., Rusk, Tex., has completed its new gray iron shop and the plant now is in operation. The principal product is sash weights.

The Superior Foundry Co., Cleveland, is erecting a two-story addition, 50 x 200 feet. The Fath Construction Co. is the general contractor. The plans were prepared by the Forest City Engineering Co., Cleveland.

The Allentown Brass & Hardware Co., Allentown, Pa., has been organized with $20,000 capital to engage in the manufacture of brass castings.

An extensive addition is being erected to the plant of the Syracuse Smelting Works, Brooklyn. This company manufactures babbitt and white metals.

The Kelly-Cohen Foundry Co., Canton, O., has been incorporated with $20,000 capital by Hyman Cohen, D. Cohen, E. L. Cohen, Thomas F. Turner, and Harrison E. Webber.

The Old Colony Foundry Co., East Bridgewater, Mass., will erect an addition to its plant. This company manufactures brass and iron castings.

The controlling interest of the Aluminum Foundry Co., Sebring, O., has been purchased by A. C. Heacock and James H. Hotchkiss. This company manufacturers aluminum hollow-ware.

An extension, 70 x 100 feet, will be built to the plant of Henry Orme's Sons, St. Paul, Minn. This company manufactures brass and iron castings.

The National Foundry Mfg. & Supply Co., Williamsport, Pa., has increased its capital from $50,000 to $100,000 and a new foundry building 50 x 200 feet, cupola house and core shop are being built.

The United States Malleable Iron Co., Toledo, O., manufacturer of malleable iron castings, has completed an addition to its foundry, 70 x 100 feet, and an addition to its core department, 70 x 70 feet.

The Indiana Brass Co., Frankfort, Ind., is erecting a large addition to its brass foundry and considerable foundry equipment will be installed, as well as machinery in the finishing department.

The Chester Gray Iron & Brass Foundry Co., Chester, Pa., organized about two years ago, has re-equipped its dismantled gray iron foundry as a brass foundry. R. M. Ridington is the owner.

The Union Brass & Metal Mfg. Co., St. Paul, is erecting a foundry, 70 x 120 feet, and the main building is being extended by an addition, 50 x 100 feet, two stories high. This company operates a brass foundry, machine shop and plating department.

The McHatton Foundry Co., Philadelphia, has been incorporated with a capital stock of $50,000, and succeeds the McHatton Smelting Co. The melting capacity of the plant will be increased. Worall A. Wagner is president, J. C. Wright is secretary and B. H. Davis is treasurer of the new corporation.

The Wisconsin Aluminum Foundry Co., Manitowoc, Wis., will extend its plant by the erection of a new building, 100 x 200 feet, of brick and steel construction. When the additions are finished, the plant will have a capacity from 10 to 12 tons of aluminum castings per day. This company has discontinued the manufacture of brass castings and hereafter the output will be confined chiefly to aluminum crank cases.

The National Brake & Electric Co., Milwaukee, is making rapid progress with the construction of its new gray iron foundry and the first heat will probably be taken off in July. The new shop is one of the largest in the Milwaukee district and includes a main molding floor, 240 x 100 feet. The plant will have a daily capacity of 75 tons and will be completely equipped with molding machines, sand-handling apparatus and other appliances for the economical production of castings.

The Bierman-Everett Foundry Co., Inc., manufacturer of malleable and gray iron castings, has completed its new plant at Irvington, N. J. Exclusive of the cupola house the foundry is 40 x 100 feet and will be devoted entirely to manufacturing welding supplies. The equipment includes a Paxson-Colliau cupola, a Sturtevant blower and six Arcade molding machines. The Bierman - Everett Foundry Co. is a new concern, recently incorporated with a capital stock of $125,000, to take over the business formerly conducted by both the Everett Co., and the Geo. Bierman Co. The officers of the new company are: Geo. Bierman, president; Wm. H. Mantz, vice president and treasurer; John E. Berlenbach, secretary.

The American Malleables Co., Lancaster, N. Y., has recently completed extensive improvements, including a 40-foot bay of steel construction extending over each of the four melting furnaces and a 65-foot addition has been added to one end of the foundry. This building is of steel and brick construction and has a continuous row of large windows on either side of a broad monitor, thus insuring ample light and ventilation. The cupola building has been dismantled, as well as the core shop, and this area, 150 x 25 feet, is now used for foundry purposes. A new core shop adjoining the foundry at its middle section has been erected. The core room has accommodations for 100 coremakers and is equipped with three batteries of rolling-drawer type ovens installed by the J. D. Smith Foundry Supply Co. The core sand is prepared in a Blystone sand mixer and a low-pressure heating system also has been installed, as well as a 150-kilowatt transformer and an Ingersoll-Rand, two-stage, 888-foot air compressor. The cleaning equipment has been increased by the addition of two New Haven sand blast mills and one Sly sand blast barrel. Seven steel shell tumblers also have been added. A dust arrester system is being installed for the soft and hard cleaning departments, this equipment having been furnished by the Cleveland Nickel Works, Cleveland.

New Construction

The American Foundry Co., Rockford, Ill., is erecting a shop, 65 x 85 feet.

The Romeo Foundry Co., South Park, Mich., is building an addition to its foundry which will double the capacity of the plant.

The International Supply Co., Medicine Hat, Alta., is building an addition to its foundry, 44 x 72 feet, and a new factory building, 56 x 112 feet.

The Summit Foundry Co., Akron, O., will erect a foundry on Kelly avenue at a cost of $10,000.

The Illinois Malleable Iron Co., Chicago, will erect a foundry, 163 x 181 feet, at its Paulina street plant.

The Wallaceburg Brass & Iron Works, Wallaceburg, Ont., Can., will erect extensive additions to its plant.

C. Shilling & Sons, St. Paul, will erect a plant for the manufacture of stoves at Elmwood, Winnipeg, Can.

The Underwood Typewriter Co., Hartford, Conn., will build a foundry at Wheeling, W. Va.

The Best Foundry Co., Bedford, O., manufacturer of stove plate, is building another extension, 180 x 200 feet.

The Warren Steel Casting Co., St. Louis, manufacturer of crucible steel castings, contemplates the extension of its manufacturing facilities by the erection of a new foundry.

The Bond Foundry & Machine Co., manufacturer of power transmission machinery, Manheim, Pa., is building an addition to its plant, 50 x 128 feet.

The Hanks Foundry Co., Rome, Ga., manufacturer of stoves and ranges, will build a new plant on a three-acre tract recently purchased.

The Industrial Iron Works, Ltd., Medicine Hat, Alta., will erect a foundry. Joseph W. Hamilton and Floyd T. Richfield are the promoters.

The Atlas Steel Casting Co., Buffalo, will increase the capacity of its molding floor and will build an addition to its cleaning department.

The Tifton Foundry & Machine Co., Tifton, Ga., is building an addition to its plant, 40 x 110 feet, of steel construction with corrugated iron sides and roof.

The Anthes Foundry, Ltd., Toronto and Winnipeg, Can., advises that the proposed $150,000 plant at Calgary, Alberta, will not be placed in operation until next year. The principal product will be soil pipe and fittings.

The Electro-Steel Products Co., Scranton, Pa., contemplates the erection of a steel foundry for the manufacture of automobile and motor truck castings. A three-ton electric induction furnace is to be installed and the capacity of the plant is to be approximately 10 tons in 24 hours. H. O. Bernhardt, 415 Miller building, is general manager.

Among the Brass Founders

The Dominion Bronze Mfg. Co. will erect a foundry at Preston, Ont.

J. M. Costello will open a brass foundry at Stoughton, Mich.

The Mauston Aluminum Co., Mauston, Wis., contemplates the erection of an addition to its foundry in the near future.

The Allentown Brass & Mfg. Co., Rittersville, Pa., will build a plant for the manufacture of brass castings.

The Paramount Brass Mfg. Co., Cleveland, has been incorporated with a capital of $10,000 by W. M. Behn and W. F. Grimmell.

The Chambray Carburetor Co., Detroit, has been incorporated with a capital stock of $50,000 by John H. Chambers, James W. Mowbray and Charles H. Bennett.

The Rochester Bronze & Aluminum Co., Rochester, N. Y., has been incorporated with $25,000 capital to engage in the manufacture of brass, bronze and aluminum castings. The incorporators are P. F. Lemke, Joseph Strauss and John J. Keefe, of Rochester.

NEW TRADE PUBLICATIONS

PORTABLE CRANES. — A 32-page illustrated booklet describing portable floor cranes and hoists has been issued by the Canton Foundry & Machine Co., Canton, O.

PISTON MOLDING MACHINE.—In a 12-page catalog the Affiliated Manufacturers, Milwaukee, illustrate and describe a machine especially designed for molding pistons, packing ring blanks and similar cored, cylindrical castings. The machines are used in pairs, one for molding the cope and the other for the drag. The catalog is well-illustrated and shows the machine in various operating positions.

POLISHING AND BUFFING MACHINERY.—The Webster & Perks Tool Co., Springfield, O., has issued an 8-page, illustrated bulletin describing its ball-bearing polishing and buffing lathes. Specifications and prices are given and a sectional view through the head of one of the lathes shows the arrangement of the bearings and the oil reservoirs.

PYROMETERS.—The line of thermo-electric pyrometers manufactured by the Hoskins Mfg. Co., Detroit, is described in a 48-page catalog issued by this company. This type of pyrometer is adapted for temperature measurements above the range of ordinary thermometers and up to approximately 1,370 degrees Cent. or 2,500 degrees Fahr. Numerous applications of this measuring instrument are illustrated and many interesting suggestions for pyrometer uses are included.

STOPPERS.—In an attractive 30-page booklet, the Joseph Dixon Crucible Co., Jersey City, N. J., illustrates and describes its line of plumbago stoppers, nozzles and sleeves. While a wide variety of styles and sizes are shown, many other types are manufactured. In making the stoppers for steel ladle use the grain of the plumbago always runs lengthwise and never crosswise and as a result the stoppers are less liable to pull loose when the stopper head freezes to the nozzle.

OXY-ACETYLENE WELDING APPARATUS.—The Davis-Bournonville Co., New York, has issued a 32-page illustrated booklet devoted to its apparatus for autogenous welding. The various styles of acetylene generators, welding and cutting torches, pressure gages and regulators are described. Approximate dimensions and weights of the different apparatus are given, and several pages are devoted to tables showing approximate cost of machine cutting, approximate hour-cost of oxy-acetylene welding, and the approximate consumption of gases per hour.

CENTRIFUGAL AIR COMPRESSORS. — The General Electric Co., Schenectady, N. Y., has issued a 20-page bulletin devoted to its centrifugal air compressors. It is stated that these compressors are capable of recovering, in the form of pressure, nearly all the velocity energy imparted to the air instead of dissipating it in the form of heat, and it is claimed that owing to the absence of valves and rubbing surfaces there is no possibility of leakage, with the consequent slippage, and necessity for renewals. Other advantages claimed for these compressors are their small size for a given output and their high speed, the latter permitting the use of direct-connected high speed drivers.

AIR TOOLS. — A 94-page catalog, issued by the Cleveland Pneumatic Tool Co., Cleveland, is devoted to its extensive line of pneumatic tools. These include riveting hammers, drift-bolt drivers, chipping hammers, sand rammers, drills, wood boring machines, etc. The catalog is well-arranged and handsomely-illustrated and contains considerable information regarding the care and use of these air-operated tools. For foundry work, a compressed air core breaker is illustrated, which is employed for breaking down heavy cores in large castings, and sand rammers of various types are shown, adapted to both floor and bench work.

GRAB BUCKET. — A 12-page illustrated bulletin, issued by the Pawling & Harnischfeger Co., Milwaukee, describes a grab bucket for handling loose sand, digging pits, etc. It is stated that this bucket operates on a single line, and therefore, the second hoisting cable and its consequent mechanism, which usually is required on grab buckets, is eliminated. It is claimed that this bucket readily can be attached to, or detached from the hook of any crane of sufficient capacity, and will not impair the regular hook service of the crane. The moving parts are designed to balance each other, and the pneumatic shock absorbers provided, not only eliminate the shocks, but also make the bucket more effective in digging molding pits, or unloading hard-packed sand from freight cars.

FACTORY FLOORS.—A handsomely-illustrated catalog, devoted to the pavement of factory floors, bridges, etc., has been issued by the Jennison-Wright Co., Toledo, O. The material employed is a wood block, either rectangular or hexagonal in form, which is treated by a special process whereby the blocks are impregnated with oil. As a result of this treatment, the blocks are made practically dust and decay-proof. The catalog contains many illustrations of installations of these wood block floors in industrial plants of various kinds, including machine shops, foundries, etc. Specifications issued by the company contain complete details covering the methods of laying the blocks with instructions regarding the preparation of a foundation for the floors.

MOLDING MACHINES. — A handsomely-illustrated and well-arranged, 68-page catalog, devoted to molding machines and accessories, has been issued by the Osborn Mfg. Co., Cleveland. This line includes plain jolt-ramming machines of various sizes and types, portable pattern-drawing machine, special type jolt machines with pattern-drawing equipment, direct-draw roll-over jolt-ramming machine, roll-over rock-down machine, direct-draw roll-over for hand and machine operation, rock-over drop-draft, drop-plate flask-stripping, deep-draft stripping-plate, drop-plate squeezer and plain squeezer. The accessories manufactured by this company include vibrators, snap flasks and trimmings, etc. The catalog is well-illustrated with views of various shops, showing the lines of work to which these different machines are adapted. Concrete examples of the capacities of these machines are included in the views of molding floors, showing the day's output of the operator by machine-molding methods.